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ORIGINAL ARTICLES

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Editorial

NINETEEN FORTY-SIX

PERHAPS it is well that one cannot look into the future and foretell coming events. The war is over, the world is in a turmoil, and many problems, readjustments and threats confront our profession. Some headaches started before the war; others were born during the conflict; a new set began with demobolization.

No one questions the wonderful work done by those of the medical profession while in uniform. The system, started prior to hostilities, of training young graduates for their future work resulted in the saving of thousands of lives, and also in returning more thousands of our service men to civilian life physically and mentally robust, who otherwise may have been human wrecks for months or years. Because of the system of medical education, intern and resident training, and teamwork, these medicos accomplished more "miracles" than did the sulfa drugs, penicillin and plasma. All thinking men hope this system, interfered with and knocked galley-west during the war, will be permitted to resume where it left off, and not have a set of arm-chair bureaucrats inaugurate a lot of new theories hardly in the blue-print stage. All interested in medical education will welcome back the established four-year medical course with summer vacations, a boon to both students and teachers. We understand this will come after this year. A move in the right direc-

tion was evidenced by a directive of the Procurement and Assignment Service, Washington, D. C., when recently they ordered that . . . "Hospitals . . . must begin at once to appoint veterans [of this war] to every staff position so that, with rare exceptions, every militant resident can be called to active duty not later than April 1, 1946 . . . " In other words, the great majority of our house-men after April 1st will be from the ranks of the honorably discharged veterans of this latest war.

We (and many others) have heard and received letters from physicians in service who complain they are not being released with speed and dispatch. Many of our newspapers have filled columns on this topic. For the duration the civilian population suffered from a depleted medical profession. Many of these not-too-young men who have serviced three or four years, the majority married and the fathers of children, complain they are the victims of a rigid and too high point system, and are twiddling their thumbs and suffering from boredom in far away outposts. By the time this is in print we hope we'll hear that these loyal medical citizens will be in the process of swiftly being returned to civilian life.

Our hospitals rendered excellent service to their communities during the war years. Without exception they worked overtime

and at full bed capacities with skeleton staffs of nurses, maids, porters, and other personnel. Right here a bouquet to The American Red Cross for the aid and service they gave to our hospitals during these trying times! They supplied volunteer nurses-aids, dieticians, clerks, telephone operators and other personnel to their full ability. It is hoped that many of our nurses will return soon to their old posts, and that before long our hospitals will be adequately staffed.

Recently, President Truman offered a "Plan" which he says is not Socialized Medicine. We read and heard over the radio (Dr. Fishbein) the claim that the "Plan" IS Socialized Medicine. Whatever the outcome we hope that we, as physicians, will not get it "in the neck" and have to labor under a system dominated by politicians and stuffed shirts who "yield to no man, etc. . . . "

Publishers and editors of scientific journals have not escaped the war years. Confronted with a serious paper shortage, government rules and restrictions, and with so many physicians in uniform and out of the country, the task of publishing a quality journal month after month has not been an easy one. But with the Peace [sic] we hope soon to get back on a prewar schedule. Even at this early date we note

an increase in the number of articles submitted for publication, and an increasingly greater number are of a high order of merit. One day we trust we will find it possible greatly to increase our yearly number of text pages. We have two Special Numbers in the making for 1946, and we hope to be able to afford more color. We intend sticking to our policy of selecting only articles that impart practical knowledge and that stimulate thought and prove valuable to the reader. That we are on the right track is evidenced in our circulation and our distribution, for we are read in every country in the world.

And so for the year 1946 it is hoped that many of our problems will be solved to our satisfaction, that our young men will be provided with means to receive the added training they need (especially true for the "3 year hurry-up group), that large funds will become available for real medical research, that the medical colleges and hospitals will quickly get back to normal, and that before the buds come out on the trees over ninety-five per cent of our physicians, now in uniform, will have been honorably discharged and back in their offices, hospitals or laboratories.

To you all for 1946, best wishes for health, contentment and peace.

T. S. W.

Original Articles

THE PHYSICK-SELLHEIM PRINCIPLE OF EXTRAPERITONEAL CESAREAN SECTION

ELUCIDATION OF A TECHNIC BASED ON 175 CASES

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NEW YORK, NEW YORK

THE purpose of this article is primarily to portray the essential steps of the Physick-Sellheim principle of extraperitoneal cesarean section. A review of the literature on this subject reveals a type of illustration which has neither clarified the operation nor aided the operator in his initial trials. Before any of the present drawings were made, the artist, Mr. Alfred Feinberg, witnessed several operations in order to obtain an adequate knowledge of the anatomic structures involved and to absorb the operator's point of view.

The technic to be described has been used, with slight variations, in 175 cases. The extraperitoneal procedure was not always indicated. This series includes instances wherein the operation was performed on surgically "clean" cases and even on non-laboring parturients. But it also includes a large number of patients in prolonged labor and with ruptured membranes, some of which had been subjected to unsuccessful vaginal instrumentation—in brief, patients commonly referred to as potentially or actually infected.

From a surgical point of view, a true candidate for an extraperitoneal cesarean must be considered below par. Prolonged labor, particularly a poorly sedated or unsedated painful labor, leads to physical exhaustion and dehydration. The added ordeal of an excessively long surgical procedure (even though extraperitoneal) may predispose the patient to certain hazards—surgical shock and postoperative uterine hemorrhage. Shock may occur on the operating table or immediately thereafter, while hemorrhage may develop following the cessation of styptic controls. To prevent shock, the usual preoperative infusions of saline, plasma and blood are held in readiness. Prolonged labor and prolonged inhalation anesthesia diminish the efficacy of uterine contractility. On this basis, adequate uterine packing is strongly advocated. In instances of unsuccessful attempts at vaginal instrumentation leading to possible trauma of the presenting cervical lip, or even lower segment, the added precaution of vaginal packing is also advisable.

Deaths. There was one death which was preventable in this series of 175 cases. It occurred in a small private sanitarium, with inadequate and incompetent intern supervision. The patient died of exsanguination, approximately sixteen hours after leaving the operating room in excellent condition. When first seen in the early hours of the morning, the patient was *in extremis.* No blood was available. To avoid a similar catastrophe, all cesarean patients should be grouped prior to operation, and bank blood should be available at a moment's notice.

Vesical Injuries. The bladder dome was opened in four instances and the posterior wall (of the bladder) was injured on two occasions. The dome injuries

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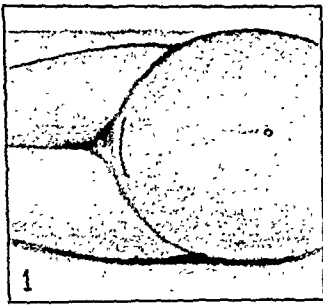
FIGS. 1 AND 2.
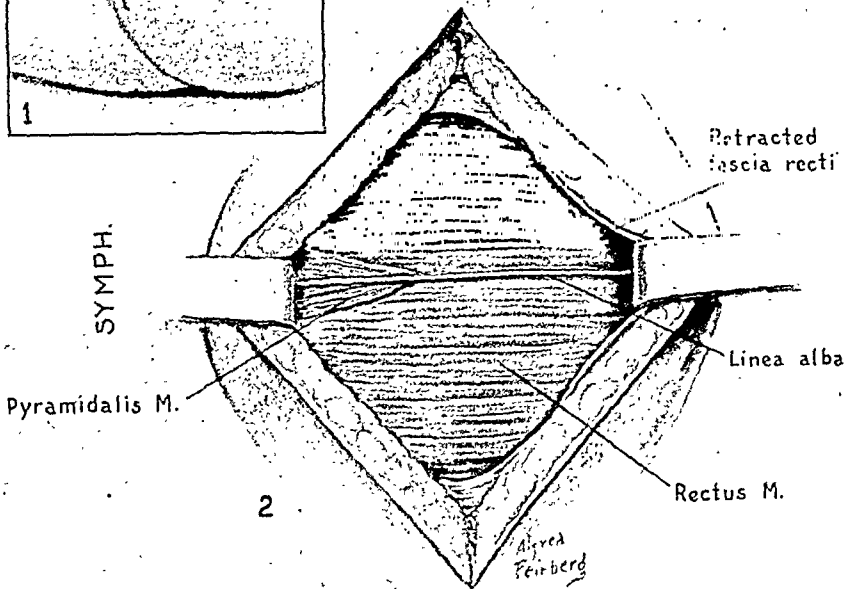
FIGS. 3, 4 AND 5.
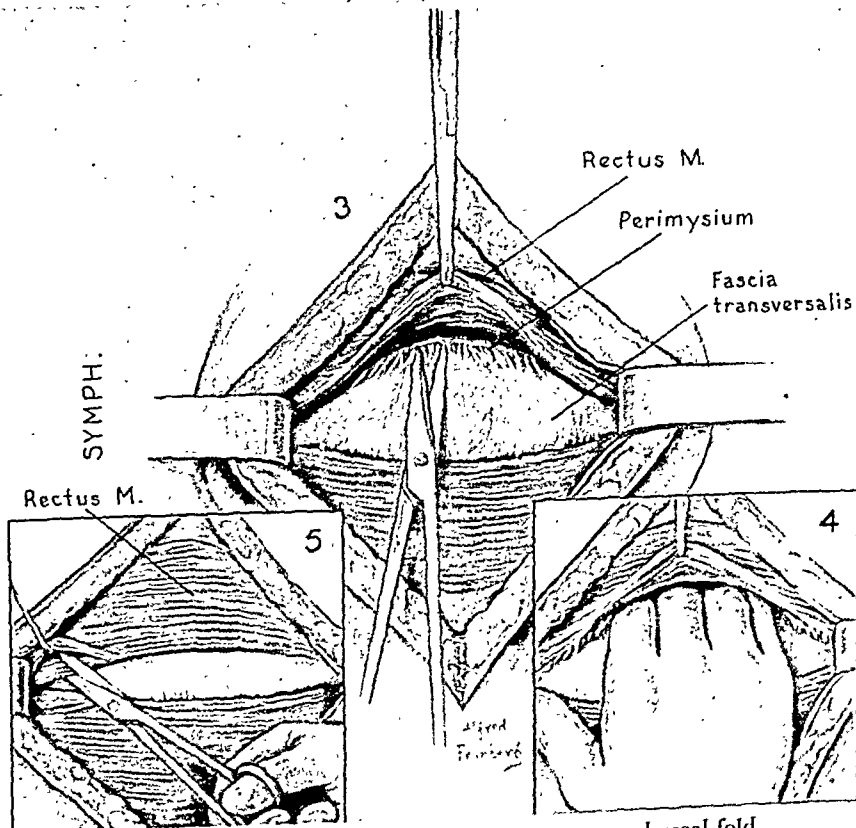
FIG. 1. Crescentic incision five inches long in the suprasymphyseal fold.

FIG. 2. Recti, pyramidalis muscles and linea alba.

FIG. 3. Cutting strands of perimysium between rectus muscle and fascia transversalis.

FIG. 4. Liberating of rectus muscle from the transversalis by a fan-shaped swing of the hand from symphysis to umbilical area.

FIG. 5. Cutting of the medial insertion fibers of both recti directly above the symphysis to facilitate lateral displacement of the recti and increase spaciousness of operative field.

usually occurred at the vesical-urachus area. The openings were small and easily managed. The rents in the posterior wall

the bladder displacement. In all instances, repair was followed by an uneventful recovery without any lengthening of the
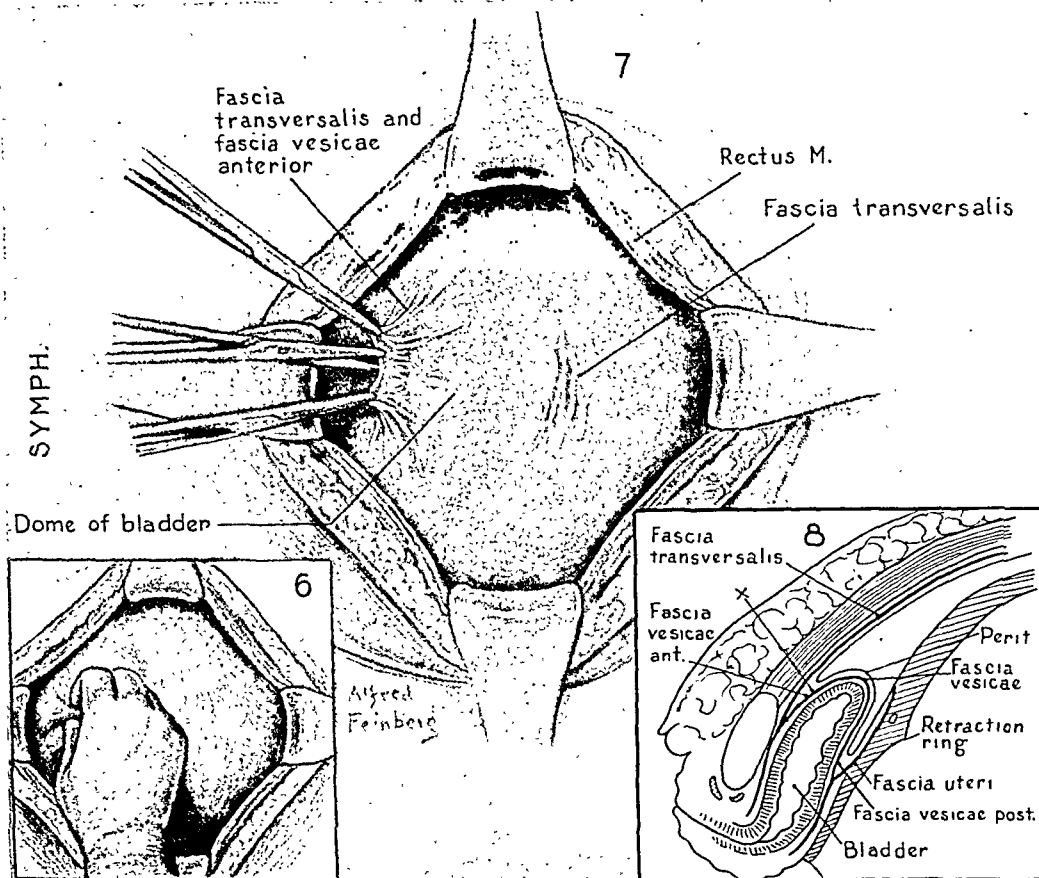
FIGS. 6, 7 AND 8.

FIG. 6. Finger massage of flattened, empty bladder. This procedure helps to contract the anesthetically relaxed bladder musculature and to loosen viscus from fascial capsule.

FIG. 7. Grasping and incising of fascia transversalis and fascia vesicae anterior one inch below bladder dome, exactly in mid-line. Both fasciae are laminated. Terminal lamination on bladder musculature is left to facilitate decapsulation and protect vesical vessels.

FIG. 8. Peritoneal and fascial relationships to bladder and lower segment exactly in mid-line. Cross (x) indicates point of incision of fascia transversalis and fascia vesicae anterior as portrayed in Figure 7.

of the bladder were fully two inches long. One occurred in a patient who had been subjected to a previous laparotrachelotomy. Here, the bladder was found unyieldingly adherent to the lower segment. The other occurred in a patient traumatized by inexperienced instrumental attempts at vaginal delivery. In this case, the lower segment was discolored by extravasated blood so that fascial identification was found difficult and a rent of the bladder musculature resulted. The mucosal lining, which appeared intact, was injured while completing

hospital stay. In two other instances, no bladder injury was noticed at the time of operation, but an ammoniacal odor appeared on the dressings for several days. Injuries to the dome of the bladder, or even injuries to the upper half of the bladder (above the ureteral orifice), must not be considered too serious if adequate repair is instituted. Here the simple but fundamental surgical principles must be followed: raw surfaces must be accurately approximated by two layers of sutures without strangulation of tissues, and the "bite"

must include sufficient to ... to guarantee
adequate blood supply to the sutured part.
In preparing of bladder done under ..., the

small opening may be managed. It can best
be repaired by grasping the edges, twisting
them, tying and anchoring the suture by

patient were catheterized every three
hours. In posterior wall ...., an in-
dwelling catheter was utilized for four days
and after it was removed the patient was
catheterized every three to four hours.
When there is frequent catheterization or
an indwelling catheter is used, urinary
antiseptics are administered.

Peritoneal Injuries. In the earlier trials
of this series, the peritoneum was fre-
quently injured. However, in this type of
cesarean, injury to the peritoneum must
be considered a serious breach of technic.
Strictly speaking, once the peritoneum is
"holed," the operation ceases to be a true
extraperitoneal cesarean. Nonetheless, a

passing the needle above the tie. Complete
liberation of the peritoneal fold is then
necessary to avoid loosening of the tie and
extension of the peritoneal opening during
the actual delivery.

Fetal Deaths. There were only seven
fetal deaths. Autopsy was performed in
four: in one case, there was an adrenal
hemorrhage, in two, congestion of the
brain and emphysema of the lungs, and in
the fourth one, an intracranial hemorrhage.
One was a monster with hydrocephalus.

Phlebitis. There were three cases of
phlebitis. In one case, the swelling of one
extremity persisted for many months.

Despite these complications, a success-

fully executed extraperitoneal operation, finished well within an hour, presents several distinct advantages in immediate

Technical Minutae and Anatomic Considerations. Examine anesthetized patient vaginally on the operating table. Dislodge
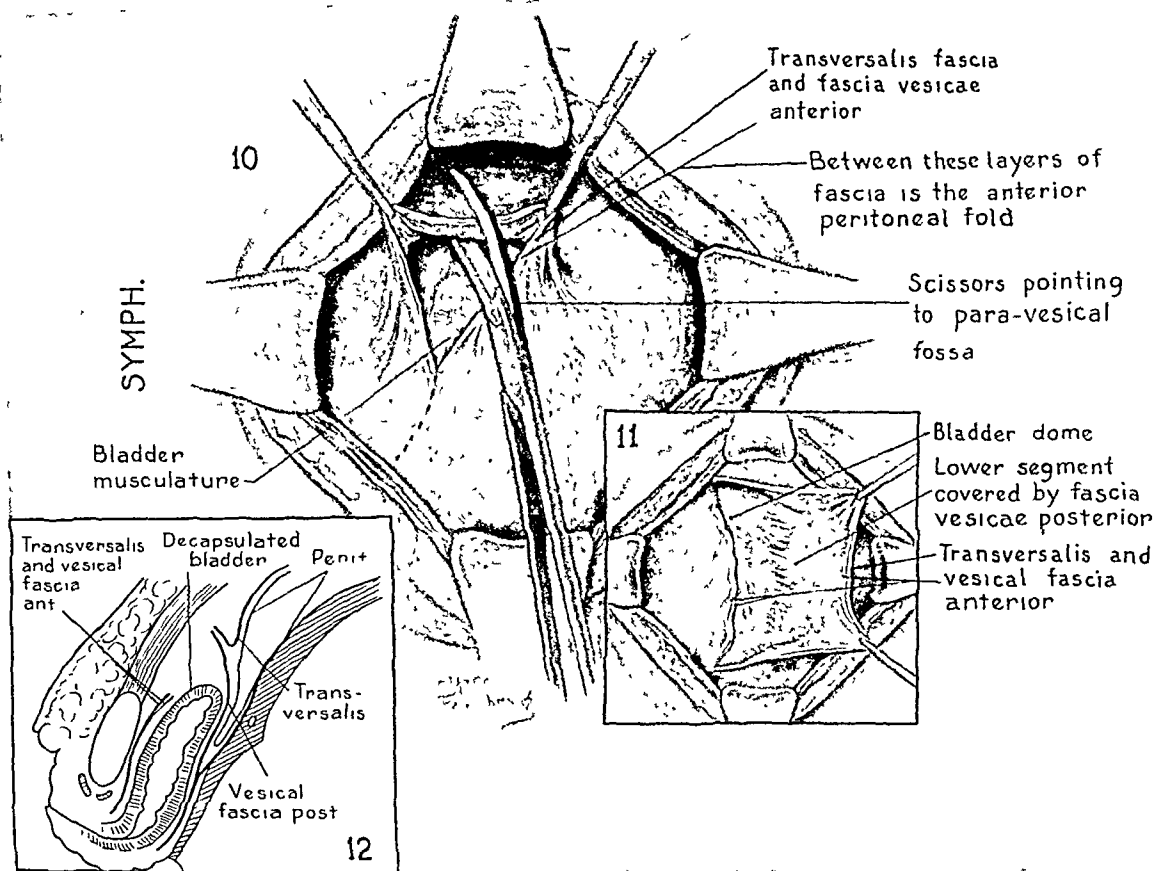
FIGS. 10, 11 AND 12.

FIG. 10. Cutting of the fasciae (transversalis and anterior vesical). Scissors curve downward to the paravesical fossa. This incision is made to right and left.

FIG. 11. Elevation of upper cut edges of fasciae (transversalis and anterior vesical). Between these two fasciae lies the anterior peritoneal fold, liberated from the anterior surface of the bladder and bladder dome.

FIG. 12. Diagrammatic presentation of Figure 11, exactly in mid-line showing the relationship of the fasciae (transversalis and anterior vesical) after being incised and liberated from anterior surface of bladder and bladder dome.

postoperative reactions over all intra-abdominal procedures. Voiding without catheterization is the rule. This is probably due to bladder manipulation during the operation, which counteracts the anesthetic muscular relaxation. Abdominal discomfiture and distention, if present, are transient and not distressing. The need for morphia is reduced. Fluids and food are relished a few hours after the operation. Cleansing the lower bowel the day following the operation hastens the feeling of comfort and well being.

an impacted fetal head in order to facilitate delivery. Pack the vagina with two inch iodoform gauze if the cervix is stumpy, uneffaced and "low." The delineating catheter, originally introduced to outline the bladder, has been completely eliminated. A completely empty bladder facilitates the operation and reduces bladder injury to a minimum. Place patient in a moderate Trendelenburg position. A five and one-half inch Pfannenstiel incision is made following the course of the supra-symphyseal fold. For accuracy and sym-

metry, locate the mid-abdominal point, eyeing the umbilicus as a guide. Make both arms of the incision symmetrical in length

Dome. Visualize and feel the empty "pancake" bladder. It lies underneath the widespread fascia transversalis and is com-
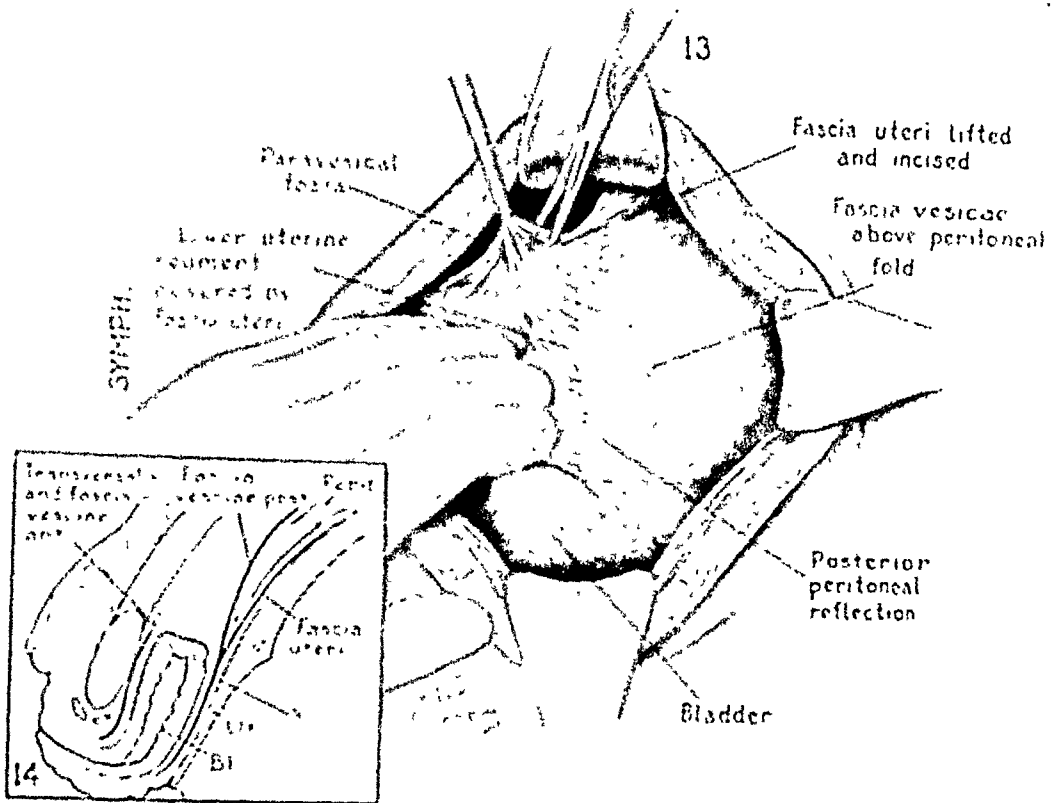
FIGS. 13 AND 14.

FIG. 13. The paravesical fascia (right) is exposed to present lateral wall of bladder, the end of the posterior peritoneal fold and the fascia uteri. The posterior peritoneal fold lies between the posterior vesical fascia above, and the fascia uteri below.

FIG. 14. Relationship of fasciae to displaced bladder and posterior peritoneal fold in mid-line. Cross (x) indicates area where fascia uteri is incised to liberate lower segment from fascial covering and permit upward retraction of peritoneal fold.

and curvature. Skin protection is advisable. Incise the aponeurosis of the recti and the oblique muscles with a pronounced curvature; cut median *raphe cephalad* a distance of three and one-half inches; and *pedad* down to the edge of the symphysis. Sever the median tendinous insertion fibers of the recti at the symphysis to facilitate lateral deviation of the recti muscles. The pyramidals need not be disturbed. These initial laparotomy steps bring the operating field into view.

FIRST MAJOR STEP OF THE EXTRAPERITONEAL CESAREAN

The Liberation of the Anterior Peritoneal Fold from the Upper Bladder Surface and

pletely enveloped (anteriorly and posteriorly) by the vesical fascia. Finger massaging of the bladder with the fascial coats for a few moments helps to contract the anesthetically relaxed bladder musculature and loosen the viscus from its fascial capsule. The smaller the bladder circumference, the easier the liberation from its lower segmental bed. A firmly contracted bladder helps to eliminate bladder injuries.

With two curved Kelly clamps, grasp the fascia transversalis and the sublying juxtaposed anterior vesical fascia about a good inch below the bladder dome, exactly at mid-point. Between these two clamps, incise all the laminations of the fasciae, except a layer closest to the musculature of

the bladder. Leaving this protective termi-
nal lamination on the bladder permits in-
sinuation of the finger and "decapsulation"
company." The anterior vesical fascia
swings completely around to cover the pos-
terior surface of the bladder, while the

15

Peritoneal reflection
pocketed between
fasciae (uteri and
posterior vesical)

Fascia uteri

SYMPH

Bladder

16

Lower uterine
segment
covered by
fascia uteri
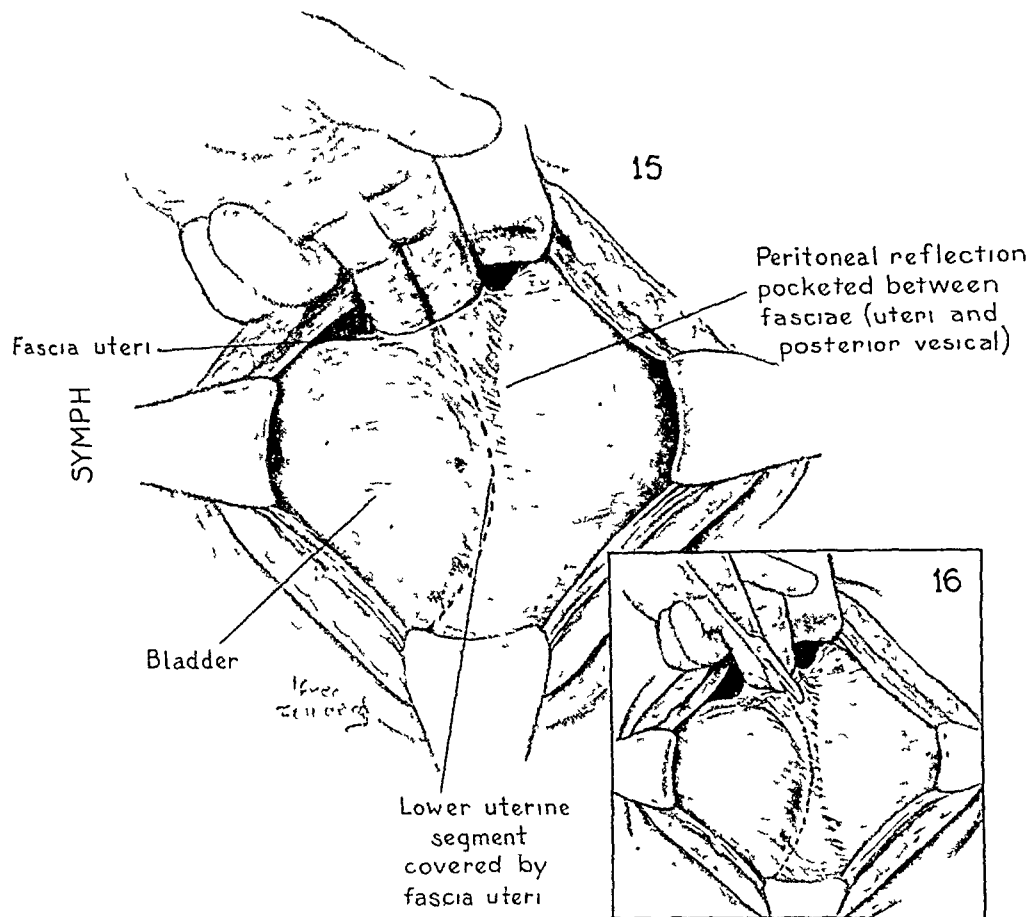
FIGS. 15 AND 16.

FIG. 15. Fingers rest on lower uterine segment and are covered by fascia uteri and posterior vesical
fascia. Dotted line indicates line of incision.

FIG. 16. Cutting of fascia uteri below peritoneal fold.

of the bladder dome with greater ease,
and minimizes injury to the tortuous
vesical blood vessels. Enlarge this incision
laterally to permit intrusion of index finger
or use a Kelly clamp. Swing the finger (or
clamp) in fan fashion from left to right,
well beyond the lateral wall of the bladder
and well over the dome of the bladder.
These liberated fasciae are incised arc-
like, curving downward behind Poupart's
ligament. This procedure exposes the para-
vesical fossa. It is to be noted that up to the
lateral wall of the bladder, both fascia
(the anterior vesical and the transversalis)
are incised; beyond these, the fasciae "part

fascia transversalis continues its spread
toward the lateral wall of the pelvis and
abdomen extraperitoneally. Make certain
that the bladder dome is free. The urachus
is seldom found troublesome, since it is
adherent to the surface of the fascia vesicae
at the dome and is, therefore, easily liber-
ated. Pregnancy tends to thin out this
structure, but when fibrous and unyielding,
it must be cut with care, hugging the
bladder fibers. This completes the first
major step of the operation—the liberation
of the anterior peritoneal fold with its
fascial protection from the anterior surface
of the bladder and bladder dome.

17

Fig. 17.

SYMPH.

Fascia uteri,
peritoneal fold,
fascia vesicae, and
fascia transversalis
retracted.

Bladder
retracted

Fascia transversalis
Fascia vesicae
Peritoneal fold
Fascia uteri

18

Figs. 18
AND 19.

Fascia transversalis
Fascia vesi-
post.
Fascia
uteri
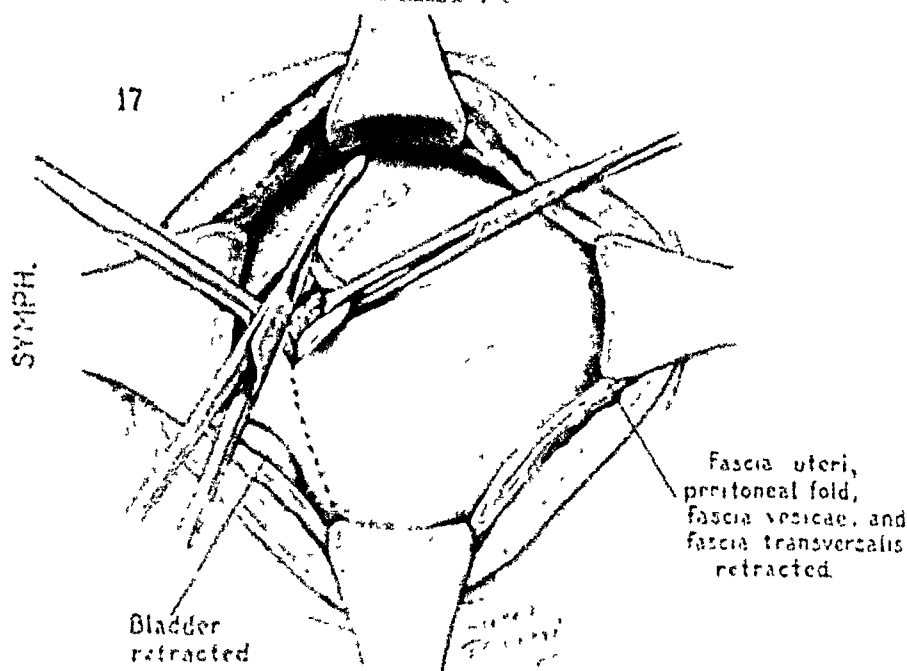
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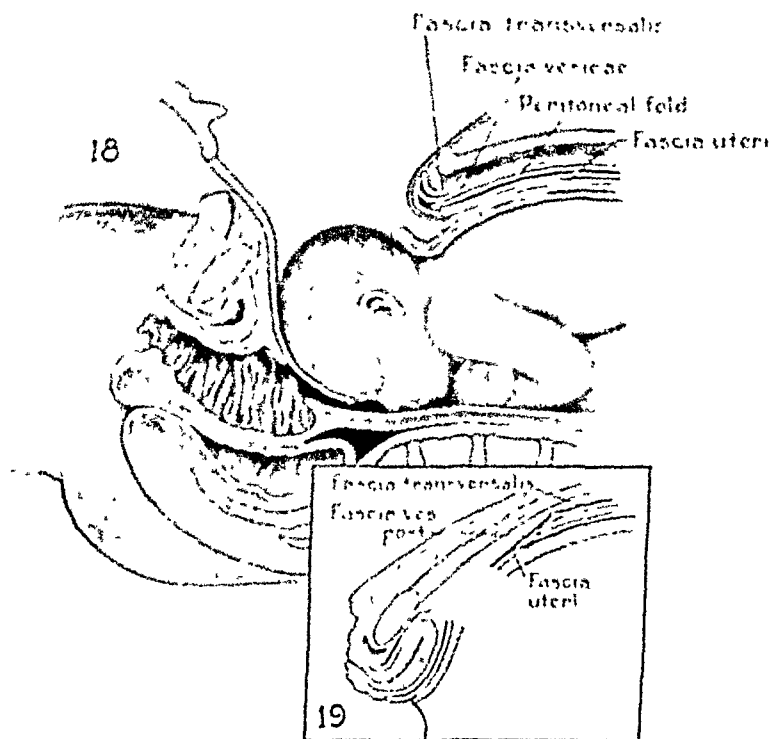
FIG. 17. Exposed lower segment. Bladder lies in the space of Retzius behind retractor
    hugging symphysis; peritoneum with fascial covering is retracted upward (cephalad).
    Crescentic incision of lower segmental muscular fibers.
FIG. 18. Vertex in anteroposterior position with solid obstetrical blade in place over
    brow. Delivery facilitated by fundal pressure exerted against obstetrical blade.
FIG. 19. Relationship between cut fascia, bladder and cut surfaces of lower segment.
    Diagrammatic representation of Figure 18.

SECOND MAJOR STEP OF THE OPERATION

The Liberation of the Posterior Peritoneal Fold from the Posterior Surface of the Bladder and Lower Uterine Segment. Expose the right paravesical fossa by careful and vigorous retraction. By blunt dissection with a curved Kelly clamp, fray the padding fatty tissue. The lateral wall of the bladder and the outermost portion of the posterior peritoneal fold and the fascia uteri come into view. The peritoneal fold appears as a grayish-white transparent apron resembling a flattened empty hernial sac. Anatomically, in this area lateral to the bladder wall, the peritoneal fold lies flattened out on the fascia uteri juxtaposed to the lower segment. Directly behind the flattened bladder, the peritoneal fold is the true vesico-uterine fold of the non-pregnant state, while lateral to the bladder, the peritoneal fold corresponds to the layers of peritoneum as it "hammocks" from the round ligament to the anterior abdominal wall. Continuing the operation in the right paravesical fossa, identify the edge of the posterior peritoneal fold, displace the bladder laterally and downward toward the symphysis. Incise the transparent fascia uteri just below the edge of the peritoneal fold sufficiently to permit insertion of index and middle finger. By insinuating fingers from right to left, the bladder is separated and elevated from its lower segmental bed. This maneuver brings into clear view the dome of the bladder, the posterior vesical fascia, the fascia uteri (the two as one structure), and the curved edge of the posterior peritoneal fold. With a scissors, cut the intervening tissue (fascia vesica posterior and fascia uteri) between dome of bladder and posterior peritoneal fold from the right to the left side of the bladder. No tissue should be incised until the edge of the peritoneal fold is clearly visible. This completes the second major step of the operation—the liberation and upward displacement of the posterior peritoneal fold and downward displacement of the bladder, exposing the entire lower segment.

Feel the presenting part retrosymphyse-ally, locate mid-point of the lower segment and make a one-inch transverse incision. Hold the knife perpendicular to musculature to avoid bevelling, which increases bleeding in the now thinned-out segment. Avoid knife injury to presenting fetal part. When the vertex is visible, grasp upper and lower cut margins with Allis clamps and insert a suture in the clamped tissue. These sutures serve as guides and for traction in the repair of the lower segment. Lengthen this incision on both sides of mid-point for about 2½ to 3 inches in crescent shape. At the extreme ends of the incision, the musculature of the lower segment thickens moderately. Again insert sutures at both ends of incision to act as guides in the repair and for hemostasis.

When the lower segment incision is completed, remove all retractors. Do not disturb presenting vertex, irrespective of position. Insert solid obstetric blade or vectis behind the occiput, the jaw or chin, depending on position. Let assistant (usually anesthetist) exert vigorous pressure fundally and laterally toward symphysis (Marr prefers version in all cases). If vertex is large and incision small, rotate vertex to anteroposterior position and deliver by extension. Immediate delivery of placenta is preceded by the use of pituitrin and ergotrate.

Locate guide sutures and by traction bring the incisional margins into view. Pack fundus and lower segment area with iodoform gauze. Repair with two layers of chromic No. 0 sutures. Elevate bladder to original position, and with several interrupted sutures, reunite the transversalis fascia. Sprinkle sulfanilamide powder over operative field and insert rubber tissue drain.

CONCLUSION

A series of 175 cases of extraperitoneal cesareans is presented with a brief analysis of the mortality, morbidity and complications. A technic is described and the steps of the procedure portrayed which facilitate and simplify the operation.

SADDLE BLOCK ANESTHESIA*

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NEW ORLEANS, LOUISIANA

AND

LIEUT. D. ROMAN-VEGA

MEDICAL CORPS, ARMY OF THE UNITED STATES

SADDLE block is a term used to designate a form of low spinal anesthesia. The term, low spinal anesthesia, usually implies that the areas supplied by the lumbar and sacral spinal roots are anesthetized. In saddle block, however, the lowermost sacral spinal segments are involved and anesthesia is confined exclusively to the saddle area. Saddle block is useful for urological, gynecological, orthopedic and obstetrical surgery.

This type of anesthesia has been described before and is by no means new.[1] However, previous reports are not sufficiently detailed, and do not describe the method of obtaining the selectivity and controllability the writers have developed. One difficulty usually encountered in the technic, as ordinarily described, is the tendency of anesthesia to spread and involve more than the saddle area during the induction period. In the writers' technic, spreading is eliminated almost entirely. Anesthesia confined exclusively to the perineal area without involvement of the legs or thighs is consistently obtained. (Fig. 1A.) By variation of dosage, timing and other technical factors, sensory anesthesia in the legs and thighs without loss of motor activity in the legs may be obtained. (Fig. 1B.) The procedure may be modified further to yield low spinal anesthesia in the ordinary sense of the term. (Fig. 1C.) The controllability in this case surpasses that allowed by low spinal anesthesia induced in the usual manner.

Previous reports have been limited to the use of procaine. The writers have extended the use of the block to other local anesthetic drugs. Pontocaine, nupercaine and other drugs capable of longer action than procaine have been employed.

MATERIALS

In performing the block, the standard set usually employed for spinal anesthesia is satisfactory. The assembly included a 20 gauge short beveled spinal needle, a 5 cc. syringe equipped with a lock which fits the spinal needle, a 26 gauge needle for the intradermal wheal and a 2 cc. syringe which fits the wheal needle. Procaine crystals, 2 cc. of 10 per cent glucose prepared in physiological saline or distilled water and 1 per cent procaine for the intradermal wheal are also necessary items.

TECHNIC

The patient is prepared in the usual manner. A hypodermic of morphine gr. ¼ to ⅙ and scopolamine gr. $\frac{1}{100}$ to $\frac{1}{150}$ is administered one hour before induction of anesthesia. Omission of sedatives during spinal anesthesia, particularly in apprehensive patients, may contribute to failure. On the other hand, oversedation often leads to a lack of cooperation by the patient while the block is being performed. A sedative dose of a short-acting bar-

biturate, such as pentobarbital, may be given orally along with the hypodermic, but is not necessary.

to perform the lumbar puncture. The best arrangement is to have the patient seated in the center of the operating table

TABLE I

VARIATIONS IN DOSAGE, VOLUME OF SOLUTION AND TIMING NECESSARY TO OBTAIN SADDLE OR LOW SPINAL ANESTHESIA WITH THE CURRENTLY EMPLOYED ANESTHETIC DRUGS

Drug	Preparation	Anesthesia in Saddle Area only (Fig. 1A)				Saddle Anesthesia Sensory of Extremities (Fig. 1B)				Motor and Sensory below L I (Fig. 1C)			
		Dose Mg.	Time Patient Sits Upright (sec.)	Duration of Anes. (hr.)	Glucose Solution (cc.)	Dose Mg.	Time Patient Sits Upright (sec.)	Duration of Anes. (hr.)	Glucose Solution	Dose Mg.	Time Patient Remains Upright (sec.)	Duration of Anes. (hr.)	Glucose Solution (cc.)
Procaine...	Crystals	50–75	35–40	1¼–1½	1	75–100	15.20	1¼–1½	1.5	100–125	0–5	¾–1	2.0
Metycaine	10% solution	50–75	35–40	1½–1¾	1	50–75	15–20	1¼–1½	1.5	75–100	0–5	1–1¼	2.0
Intracaine.	Crystals	20–25	35–40	1¼–1½	1	25–30	15–20	1¼–1½	1.5	30–35	0–5	1–1¼	2.0
Monocaine	Crystals	35–50	35–40	1¼–2	1	50–75	20	1½–1¾	1.5	75	0–5	1¼–1½	2.0
Pontocaine	Crystals or powder	5	35–40	2–2½	1	5–8	20	2–2½	1.5	8–10	0–5	2–2½	2.0
Nupercaine	0.5% solution	2½	40	3½–4	1	2½–5	20	3½–4	1.5	5	0–5	3–3½	2.0

A solution of local anesthetic drug and glucose is prepared for intrathecal injection. If procaine hydrochloride is employed, the crystals are dissolved in the necessary amount of glucose solution. (Table 1.) The mixture is drawn into the syringe and set aside until the lumbar puncture is performed. It is desirable to prepare the solution in advance of the lumbar puncture. The possibility of failure due to dislodgment of the needle by sudden movements of the patient while the solution is being prepared is thus averted. The time-honored custom of withdrawing spinal fluid and mixing it with the anesthetic drug is dispensed with in this technic. The upright sitting position must be used

with legs dangling over one side and arms folded across the chest. The patient's shoulders are supported by an attendant who faces him as he leans slightly forward. The fourth interspace (between lumbar 3 and lumbar 4) is preferred for the puncture but the third may be used if difficulty is encountered. The syringe containing the solution is attached to the needle and aspiration is attempted to determine whether or not spinal fluid flows freely. Not more than 1/10 cc. of fluid should be aspirated into the syringe during this maneuver, otherwise the solution becomes diluted. Should the spinal fluid not flow freely, the syringe should be disconnected, the stylet replaced and the needle readjusted

until a satisfactory puncture and flow are obtained. The majority of failures in spinal anesthesia are due to unsatisfactory lumbar punctures.

than spinal fluid. The solution, therefore, gravitates downward, aided of course, by the upright position of the patient. If the patient is placed in the recumbent position
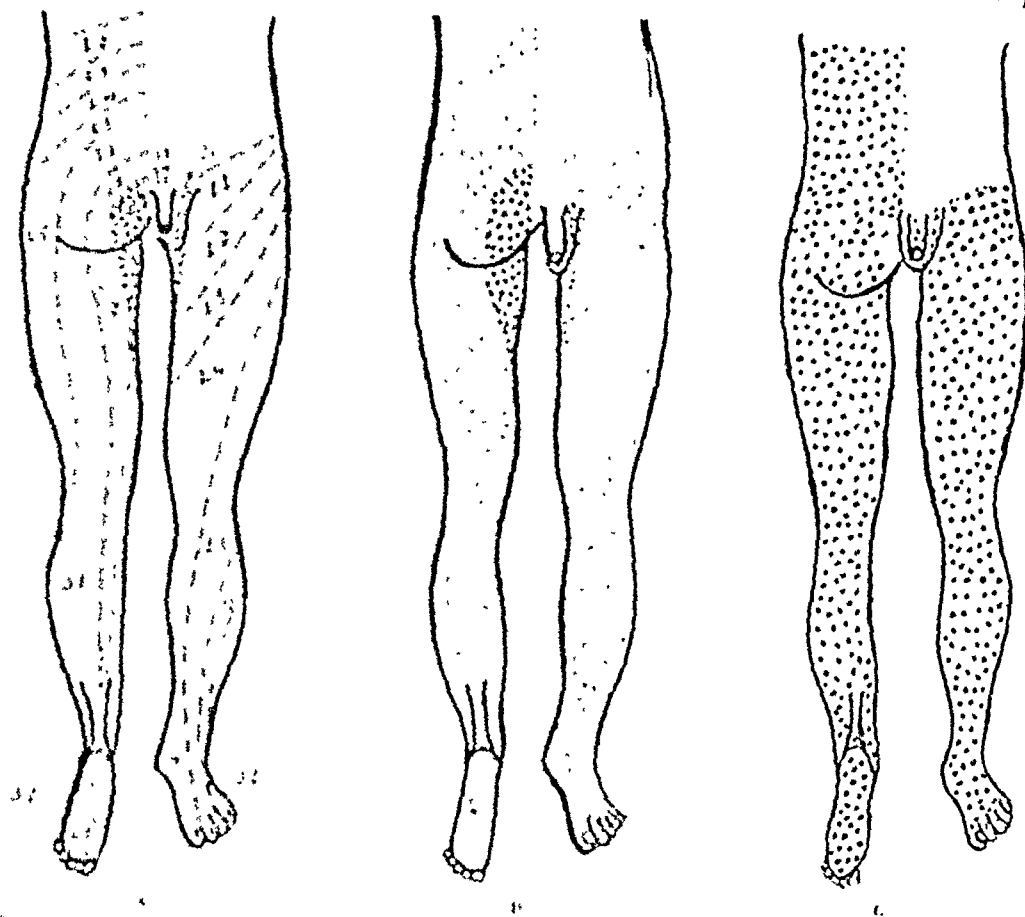
Fig. 1. Distribution of anesthesia which may be obtained by varying the technic for saddle block. Heavily dotted areas indicate motor paralysis and sensory anesthesia. Lightly dotted areas indicate sensory anesthesia without motor paralysis.

The solution is injected as rapidly as it will flow when gentle pressure is applied to the plunger of the syringe. The needle must be held firmly with the left hand during the injection. This detail is of utmost importance because failure to obtain anesthesia after an apparently satisfactory lumbar puncture is due to dislodgment of the needle during injection of the solution. After the injection is completed and the needle is withdrawn, the patient must remain in the upright sitting position for a period of time to be determined by the extent of anesthesia desired. The glucose, as demonstrated by Sise,[2] causes the procaine solution to be hyperbaric or heavier

immediately after completion of the injection, the solution mixes with spinal fluid in the lowermost portion of the spinal canal and becomes partly diluted. The procaine thus is distributed along the lumbar and sacral segments. If the patient sits upright for a period of forty or fifty seconds, the drug becomes concentrated in the conus and undergoes little or no dilution with spinal fluid. Anesthesia in this case is confined to the saddle area.

It is well recognized that sensory fibers of a nerve are affected more readily than motor fibers when exposed under similar circumstances to a given concentration of a local anesthetic drug. It is possible, if a

local anesthetic drug is sufficiently diluted in the subarachnoid space, to obtain sensory anesthesia with little or no motor

procaine and by allowing the patient to remain upright for thirty to forty seconds. Occasionally there may be some hypal-
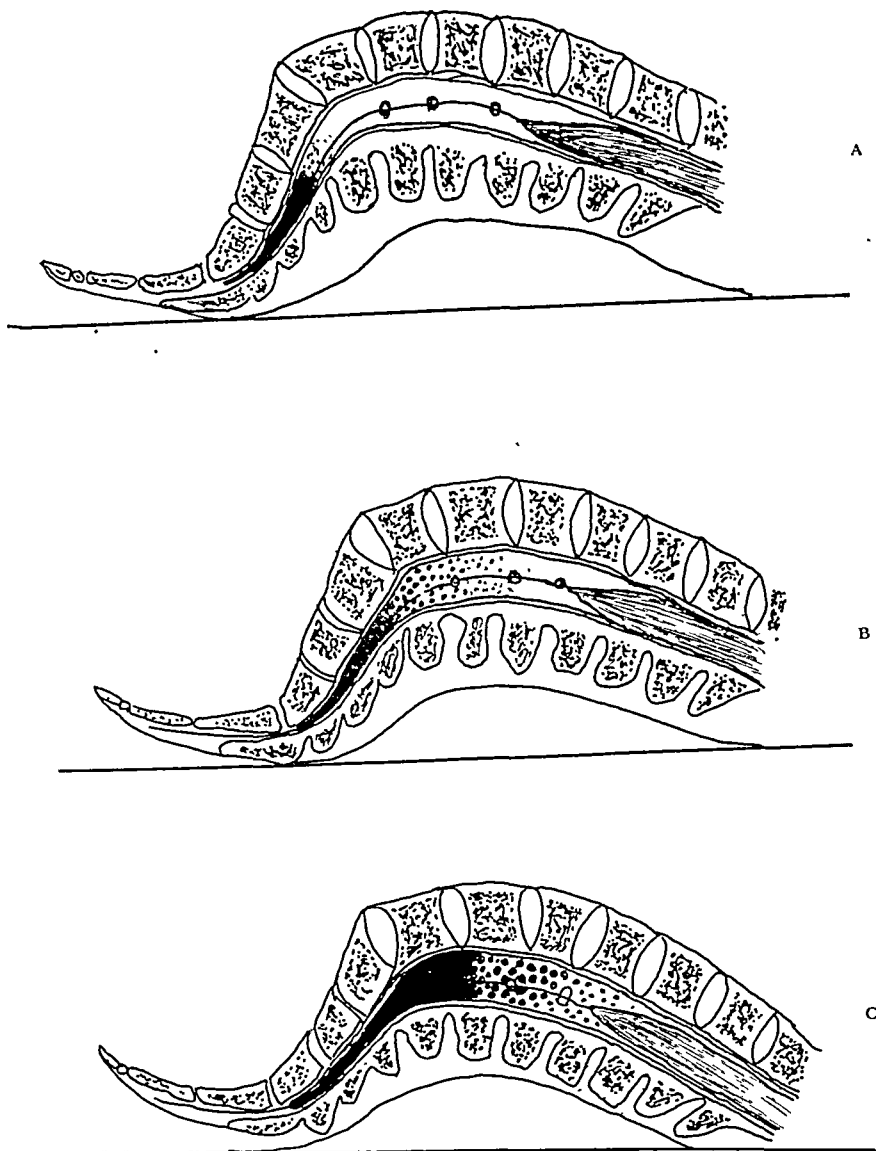
FIG. 2. Variations in concentration of the drug in the conus of the dural sac and their relationships to the extent of anesthesia obtained. Black area indicates concentration sufficient to affect motor as well as sensory fibers. Dotted areas indicate dilution which affects chiefly sensory fibers. In A, the concentration corresponds to distribution of anesthesia shown in A of Figure 1; B corresponds to B of Figure 1 and C to C of Figure 1.

paralysis. In this technic, selectivity of distribution and degree of intensity are obtained by varying the dilution at the different spinal segments. (Fig. 2.) Proper dilution is obtained by varying the amount of drug, volume of solution and the time which the patient remains upright. Anesthesia confined entirely to the perineal area may be secured by using 50 to 75 mg.

gesia, but usually no anesthesia at all is obtained over the legs and thighs. This extent of anesthesia is satisfactory for rectal, urological, gynecological and other perineal operations. Excellent relaxation of the pelvic floor and sphincters is obtained. This distribution of anesthesia, however, is not satisfactory for operations upon the fundus of the uterus, such as one

requires for vaginal hysterectomy, or upon the bladder. These parts receive innervations from the lumbar nerves which, in this case, are not affected by the drug. Analgesia, with no loss of motor activity in the legs, results when 75 to 100 mg. procaine are employed. The patient is allowed to remain upright a shorter interval, usually ten to fifteen seconds. The perineal area and genitalia are completely anesthetized and the muscles of the pelvic floor are relaxed. This distribution of anesthesia is desirable when the lithotomy position is contemplated. In long operations, the awkward position causes discomfort if the legs and thighs are not anesthetized. Motor and sensory anesthesia below the 1st lumbar segment may be obtained by using 100 to 120 mg. procaine and placing the patient in the recumbent position immediately or within several seconds after completion of the injection. Orthopedic and other operations about the extremities which require muscle relaxation and this distribution of anesthesia may thus be performed.

As soon as the patient is placed in the recumbent position, the head is supported by a pillow and the table is tilted to the reverse Trendelenburg position at an angle of approximately 5 degrees. A caudad, rather than cephalad migration of the solution, is thereby assured. "Creeping" or spreading of anesthesia beyond the desired segment is thus averted. The patient must remain in the inclined position for a minimum of five minutes before being shifted to the Trendelenburg, lateral, Sims or other position necessary to complete the operation. The glucose becomes diluted with spinal fluid after this period of time and no longer causes a cephalad advancement of the drug in the spinal canal. The onset of anesthesia when glucose is used with procaine requires a somewhat longer period of time than when procaine alone is injected. In many instances, five minutes or more may be necessary for motor paralysis and sensory anesthesia. Hypalgesia, which precedes

anesthesia, ensues almost immediately. The duration of anesthesia varies from one to one and one-quarter hours. A sensory examination should be performed to determine the distribution of anesthesia before the operation is allowed to proceed. The testing is done by light pin scratches which the patient identifies as different degrees of sharpness at first. Later, the feeling of numbness becomes apparent. Once anesthesia is established at the desired segment, there is little tendency for it to "creep."

Metycaine, nupercaine, pontocaine, monocaine, intracaine and other drugs may be substituted for procaine with minor variations in technic. Dose, time, volume of solution, duration of anesthesia and other necessary details for using each drug are listed in Table 1. The technic is fundamentally the same regardless of the drug employed. The onset of action with each of these drugs, as in the case of procaine, is longer when glucose is used than when the solutions are prepared with water or spinal fluid. Certain anesthetic drugs, notably metycaine, nupercaine, and pontocaine are dispensed in sterile solutions in sealed ampules by the manufacturer because the crystals dissolve slowly or because they require buffers to maintain stability or prevent precipitation. The solution which provides the smallest bulk is preferred in this technic because dilution of the glucose is undesirable. Besides, the success of the technic depends upon the use of a small volume of solution.

Although the dose employed depends principally upon the extent of anesthesia desired, the age of the patient frequently is an additional consideration. Subjects in the upper age groups should receive the lower limits of the tabulated dose range; young vigorous subjects, the upper limit. Body weight, length of spinal cord and similar factors are not necessary in estimation of dosage unless extremes of height and weight are encountered, in which case the upper limits are used for tall subjects and the lower limit for short.

RESULTS

In 500 surgical procedures involving the perineum, rectum, genitalia and lower extremities, saddle block was induced in 79 per cent and ordinary low spinal in 21 per cent of the cases. Patients varied from fifteen to eighty years of age. Procaine was employed in 55 per cent, nupercaine in 26 per cent, pontocaine in 11 per cent, monocaine in 3 per cent, metycaine in 3 per cent, and intracaine in 2 per cent of the cases. Anesthesia in the majority of the blocks was confined to the perineal area. In seven subjects in whom no satisfactory anesthesia was obtained, the procedure was repeated after ten minutes. Satisfactory anesthesia was obtained after the second attempt. Presumably the failures were due to unsatisfactory lumbar puncture.

No unusual postoperative complications ascribable to the anesthetic were encountered in this series. Nausea, and vomiting appeared in approximately 2 per cent of the cases. Inhalation of oxygen offered relief. Post-lumbar puncture headache was noted on two occasions. The possibility of this annoying and unavoidable complication may be considered an objection to the block. Neurological complications such as palsies, rectal incontinence, paresis of the extremities, which occasionally follow spinal anesthesia, did not appear in any instance in any patient in this series during the period of hospitalization.

COMMENTS

Spinal anesthesia causes a number of physiological disturbances, the severity of which is usually proportional to the distribution and intensity of anesthesia. These physiological disturbances and their attendant side affects are minimal in saddle block. The most common, serious and vexing complication in spinal anesthesia is hypotension. The mechanism causing hypotension, even though it has been the subject of considerable study, is not clear. The circulatory depression occurs somewhere in the periphery, probably in the veins, venules and capillaries. The relaxation of the muscles, the decrease in intra-abdominal pressure, the reduction in the intrathoracic negative pressure which follow the diminution of ventilation from intercostal paralysis, all cause a decrease in the venous return to the heart which in turn results in a decrease in cardiac output. The relaxation of the spleen and dilatation of the vessels in the skin from sympathetic paralysis contribute further to the circulatory depression by causing stagnation of blood in the arterioles, venules and capillaries. The greater the number of dermatones involved and the greater the degree of motor paralysis, the more frequent and severe is the hypotension which ensues. Saddle block offers a distinct advantage in this respect because only the area necessary to complete the operation is anesthetized. The circulatory depression, therefore, should be minimal, or entirely absent if only the sacral spinal nerves are involved. It is poor practice to anesthetize more of the body area or to induce anesthesia of greater intensity than is necessary to complete the operation. This, however, is a frequent error committed by individuals not familiar with the technic of spinal anesthesia.

Approximately 10 per cent of the subjects in this series developed some degree of circulatory depression. In each instance, it was successfully overcome by parenteral administration of ephedrine or neosynephrine. The preoperative administration of vasopressor drugs as a prophylactic measure is unnecessary. In fact, it is undesirable as it often causes an elevation of blood pressure above normal. The drug should be held in readiness and given intravenously if indicated. Hypotension did not appear in any subject in whom anesthesia was confined entirely to the perineal area. In the majority of instances, it was observed when anesthesia extended to the first lumbar segment. The wisdom of using spinal anesthesia in the presence of cardiovascular disease, hypertension, lowered vital capacity, anemia, and other severe

and remain in the common duct, growing in size, and finally producing obstructive symptoms.

The age incidence of the surgical and non-surgical groups is shown in Table III. There is no particular difference in the age groups, the greatest incidence for common duct stone being between the ages sixty to sixty-nine years. However, the peak of surgery for the females is ten years younger than that of the male which may account for some of the difference in mortality.

TABLE III
COMMON DUCT STONE
Non-surgical

	20–29	30–39	40–49	50–59	60–69	70–79	80–89	90–99
Total	2	0	8	14	18	20	8	2 –72
Male. ...	0	0	1	6	9	8	4	2 29
Female ...	2	0	7	8	9	12	1	0 42

Surgical

	20–29	30–39	40–49	50–59	60–69	70–79	80–89	90–99
Total.......	3	6	10	13	16	12	1	61
Male........	1	1	4	3	9	6	0	24
Female......	2	5	6	10	7	6	1	37

Many are under the impression that it is only the elderly who die from this condition, but from the statistics accumulated approximately 66 per cent or two-thirds are below seventy years of age. Most of these patients have had recurrent attacks of biliary colic extending over a period of years. The seriousness of this condition is not sufficiently appreciated and too much emphasis cannot be placed on the fact that common duct stone ranks first as to the cause of death from the surgical diseases of the biliary tract. While it is true that surgery carries with it a high mortality when stone is present, nevertheless, one is also struck by the frequency even with definite indications that the ducts were not explored, and how frequently even in face of exploration common duct stones were overlooked.

Out of a total of sixty-two operative cases there were thirty-four autopsies

obtained, eight of which or 23.53 per cent showed common duct stones which had been overlooked after the ducts had been explored and definite signs and symptoms of common duct obstruction were present before surgery.

It is true that these patients are poor risks and there is no doubt that it is the duration of the disease that produces both the surgical and non-surgical sequelae, and it is only through early surgery that there will be a substantial reduction of mortality. (Table IV.)

TABLE IV

Cause of death (autopsy)	Non-surgical	Surgical
Cholangitis and suppurative cholangitis....................	24	4
Cirrhosis.....................	10	1
Common duct stone.............	6	2
Phelophlebitis.................	2	0
Subphrenic....................	2	2
Liver abscess.................	2	1
General peritonitis.............	1	5
Perforated duct.................	1	2
Arteriosclerosis.................	1	1
Ruptured gallbladder............	1	0
Bile peritonitis...............	1	
Pericholecystic abscess...........	1	
Overlooked common duct stone....	..	8
Hepato renal syndrome..........	..	3
Shock........................	..	3
Perforated duodenum............	..	1
Perforated colon.....	..	1
Total autopsies...............	52	34

As noted from the above table cholangitis and suppurative cholangitis played the principal rôle in the causation of death. Cirrhosis of the liver was second which bears mute testimony of a long continued biliary tract disease.

It is noteworthy in studying the above table that the respiratory cause of death is entirely lacking. The postoperative pulmonary complications which usually rank near the top in producing the mortality played no part in these deaths, for the pathologist ascribed their cause entirely to the sequelae of common duct stone.

CHRONIC LUMBAR BACKACHE

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WHEN man assumed the upright posture he not only set himself apart from the animal kingdom, but he also set the stage for a series of disorders of the low back which have plagued him since. Probably in the whole field of medicine there is nothing that so challenges the ability of the practitioner, not only from the standpoint of diagnosis, but also therapeutically. No age group, except possibly the very young, can be said to be exempt, and the greatest incidence occurs in the most physically active part of life.

It is, therefore, important for anyone who has the responsibility of observing and treating these patients to recognize and differentiate the various pathological factors involved. Proper treatment may then be instituted early. In this way long drawn out disability may be avoided in many cases. However, when one considers the low back from an anatomical standpoint, one is impressed with the fact that there are not more people troubled with disability in this area.

I do not intend in this paper to concern myself with such entities as protruded intervertebral disc, neoplasms, infections, arthritis, etc., except to recognize that they do exist. I am more concerned with low back conditions which remain after the above have been excluded and which may be even more troublesome to treat.

The lumbosacral area is subject to a great variety of anomalous conditions, and it is certainly true that these may produce a weak back; however, from an x-ray standpoint there are other cases in which no distinct deviation from the normal can be found. In these a careful physical examination will often reveal important findings which will clarify the condition, and give us a firmer footing on which to base our therapy.

COMPARATIVE ANATOMY

In studying the low back it is well to pause for a moment and consider our inheritance, such as it is, from our primate ancestors. For an immediate example of a spinal column of primate type we may observe that of the newborn infant, in which the column at birth is practically straight. The hips are flexed and attempts to extend them meet with considerable resistance. The lumbar region of the human spine measures 27 per cent of the presacral spine at birth. This is the same as the adult chimpanzee. Elongation takes place as the child grows and in the human adult the lumbar spine becomes 32 per cent of the total presacral length.[1] As the child begins to extend the legs in kicking a gradual curve appears in the lumbar spine, which at five months becomes quite pronounced. Between thirteen months and three years the lumbar and thoracic curves are quite well established, due in part most likely to assumption of the upright posture.[2] In this short period of time the child passes through stages the counterpart of which man, in his greater development, has taken thousands of years to progress through.

To accomplish the upright posture certain changes or modifications of the primate skeleton have occurred, particularly in the pelvis and lumbosacrum. The ilia have enlarged, widened and spread out in the form of a basin offering easy support for the abdominal viscera.[3] The lumbar spine was shortened by sacralization of the seventh, then the

sixth lumbar vertebrae, and strengthened to become a flexible lever on which the whole weight of the upper part of the body is poised. Due to the disappearance of the tail, the dorsal surface of the sacrum became free and tipped backward for the encroachment of the erector spinae muscles. However, Sir Arthur Keith states, that not a single new muscle has been added to accomplish the orthograde posture. Evolution proceeded by combining a series of independent fasciculi acting individually to form a single muscle which acts on a region as in man rather than on a single vertebrae as in the gibbon. The brunt of adaptational changes has fallen on spinal musculature of the lumbar region.[4] This may to the discerning observer offer a clue to our present difficulties.

In order to accommodate for the upright posture other changes must of necessity have taken place. The lower limbs must have early assumed the human form, and as headward sacralization occurred the lumbar and sacral plexuses also moved in this direction. The thorax was transformed in shape, not for respiratory purposes but for postural purposes, the dorsal musculature of which became better developed to aid as spinal balancers.[5] At the upper end of the spinal column, the neck became more apparent and with the development of the cervical curve man lost his crouching posture and became a being unto himself, the only living creature able to walk erect.

Thus we can see that we are concerning ourselves with a region of the body which not only has been subjected to a great deal of change during the evolutionary process, but is not yet in equilibrium. There is probably no other part of the skeleton so subject to anomalies as is the lumbosacral area. It also has assumed the burden of upright posture without additional musculature; that present was merely strengthened.

These then are factors over which we have no control. There are other conditions which we can control and which we shall discuss.

ANATOMY

Most everyone is familiar with the general anatomical details of the lumbosacral region; however, there are certain points worthy of mention. The lumbar spine may be thought of as a complex universal joint operating upon a fixed base, the sacrum and ilia. It is held in position by a system of ligaments and muscles which are quite complex in their arrangement. The most important ligaments and the ones most subject to strain will be those connecting the mobile spine to the relatively fixed sacrum and ilia. In the mobile portion of the spine the ligaments are the supra and interspinous, ligamentum flavum, posterior and anterior longitudinal, intervertebral fibrocartilage, capsular and intertransverse ligaments. At the junction of the spine with the sacrum the intertransverse ligaments are modified to form in one case the fan-shaped lumbosacral ligament attached above at the inferior border of the transverse process of the fifth lumbar spreading out to the alae of the sacrum, and the iliolumbar ligament which extends from the last lumbar transverse process to the inner lip of the iliac crest.[6]

The muscles which include the erector spinae group, psoas major and quadratus lumborum lying posteriorly, may be said to act as elastic ligaments in addition to their function as spinal balancers. Motions at this joint include flexion and extension, lateral bending, slight rotatory and gliding. Rotatory motion is not possible in other segments.

The nerve supply to the lumbosacrum comes from the posterior primary division of the fourth and fifth lumbar nerves. It is well to remember that these nerves are surrounded by a large venous plexus, congestion of which may produce pain. G. A. G. Mitchell, quoting Boniot and Forestier, states that the fourth and fifth lumbar nerves are not protected by

an arachnoid sheath, making them more subject to variations in venous pressure. This observation has not been confirmed.[7]

It is well to mention something of the lumbosacral angle and width of the fifth lumbar intervertebral disc. Von Lachum, some years ago at the New York Orthopedic Hospital and Dispensary, determined the average angle to be 42.5 degrees. He considered the lumbosacral angle to be that angle formed by the plane of the superior surface of the sacrum with the horizontal. This angle should more properly be called the angle of the sacrum rather than the lumbosacral angle. This measurement has wide variations as I have found in a study of a series of x-rays in both normal people and those having back pain at the New York Orthopedic Hospital.[8] The width of the fifth lumbar intervertebral disc also varies, but seems to be more frequently narrow in backache cases. Brav, Bruck and Fruchter reported standard disc measurements to be as follows:

Posterior disc, male   5 mm.
                female 5 mm.
Anterior disc, male   18 mm.
               female 13 mm.

In a series of seventy backache cases as compared with thirty-five normal controls these men found thin posterior disc in 20.6 per cent of backache cases as compared with 5.3 per cent of controls, and thin anterior disc in 19.1 per cent back cases and in 17.1 per cent of controls.[9] What significance may be attached to a thin disc is difficult to say. When a disc is very thin it is certainly evidence of degeneration if a protruded intervertebral disc has been eliminated.

SYMPTOMS

Symptoms may be divided into acute and chronic. In the acute variety occurring most often following trauma such as a slip or fall or unusual lifting, there may be excrutiating pain in the low back sometimes rather generalized and some-times quite localized. There is usually considerable muscle spasm in the erector spinae group and often referred pain to the posterior aspect of either or both legs. It is frequently quite difficult to examine these patients properly because of pain. Under these circumstances it is best to put them in bed for a period of twelve to twenty-four hours with analgesics and heat and an attempt then made to examine them when the acute symptoms have subsided. A much more intelligent analysis of the situation can then be made.

The chronic variety with which we are most concerned may have a more or less insidious onset, or may have had its origin rather acutely following some sort of trauma after which chronic symptoms persist. The most constant symptom is dull pain, sometimes sharp, aggravated by movements. It is present more or less constantly in the lumbosacral region although it may radiate out to the loins. It may be referred down the posterior aspect of one or both legs. In some cases it is present in the legs or thighs early, later subsiding, then returning on other occasions. Such referred pain is not necessarily sciatica, a term rather loosely applied to indicate any pain in the posterior portion of the thighs or calves. Some patients localize the pain just at the lumbosacral junction in the midline, whereas others will indicate a wide area on either side as the site of pain.

In some cases the pain is present on arising in the morning, whereas in others it occurs only after being up for several hours. In some cases it may disappear after the patient arises and limbers up. Some individuals will state that rest in bed relieves them, and in private practice we often see patients who have spent weeks in bed only to have their symptoms return when on their feet again. In others going to bed merely adds to their suffering.

Thus it can be seen that there is no constant pattern, but that each individual case must be studied on its own merits, and a conlusion drawn on that basis.

DIAGNOSIS

The effectiveness of therapy rests upon a very careful physical examination, which should include all parts of the body. Ordinary routine laboratory studies such as blood and urine examinations are done and x-ray studies made which will include a lateral, an anteroposterior, and an anterior forty-five degree oblique view through the lumbosacral joint.

The examination of the back can then be carried out as follows: It is upon this examination that the program of therapy described later will stand or fall, for it is here that cases requiring some specific form of therapy must be eliminated.

With the patient standing, observe the general posture and muscle tone. Note any undue prominence of the abdomen. Note the position of the legs, their symmetry, and whether or not they are of equal length. Note the presence or absence of foot deformities, particularly flat feet.

Observe the contour of the spine. Note any deviation from the normal such as scoliosis, increased lordosis, or kyphosis; also any depressions at the lumbosacral joint which might indicate a spondylolisthesis. Note the contour of the erector spinae muscles on either side of the spine.

The patient may then be asked to carry out the usual motions of the spine: flexion, extension, lateral bending and rotation both right and left. Frequently limitation of motion will be noted, in addition to spasm of one or both erector spinae muscles. The patient may complain of pain in the posterior thighs on anterior flexion. Palpate the muscles with the finger tips during the active motions. Palpate the lumbosacral junction, the iliolumbar ligaments, the sacroiliac junction and the sciatic notch for painful points, also the sciatic nerve in the posterior thigh.

The same observations are to be made with the patient seated. This position puts some tension on the hamstring and gluteal fascia and may change the picture somewhat. The pelvis is also flexed when seated, which in some patients creates a more normal alignment of the spine.

With the patient lying down, the following tests are to be carried out beginning with the patient lying face up. As the examiner progresses through the tests the patient simply continues to roll over thus saving time for the examiner.

Gaenslens Test. Drop the right leg over the edge of the table in hyperextension. Acutely flex the opposite leg and apply gentle pressure passively in each direction so as to increase the flexion on the left and the hyperextension on the right. It should be repeated for the opposite side in like manner. This applies a shearing force to the sacroiliac joint and should give discomfort in the presence of pathology.

Goldthwait Test. With the knee in flexion, flex also the hip on the same side. Gradually extend the knee and note the amount of extension possible. Repeat on the opposite side. This test· gives us information regarding the presence of hamstring spasm. Normally the knee can be extended to 180 degrees.

Straight Leg Raising. With the knee in extension gradually flex the hip on the same side. Limitation of flexion to more than 100 degrees may indicate tight gluteal or hamstring fascia or hamstring spasm.

Lagueres Test. Flex the right knee and hip, externally rotate and abduct the thigh. This test should elicit spasm and pain in the presence of hip joint disease. The test is repeated for the opposite side.

Ober Test. With the patient now lying on the left side, acutely flex the left hip and knee. Gradually hyperextend the right hip, allowing it to drop into adduction when it has fully extended. Tight tensor fascia will prevent it from adducting under these conditions. It can be repeated for the opposite side when the patient is rolled over in the progress of the tests.

Ely Test. With the patient lying face downward and hips extended, the examiner passively flexes the knees. If the quadriceps

fascia is tight, the buttock will raise on that side.

By listing only these tests I do not mean to imply that they are the only ones in use. There are many others of equal value. The important point is to know certain tests and their value in diagnosis.

With the patient now lying face down it is possible carefully to palpate the spine, the iliolumbar ligaments, the sacroiliac joints and posterior superior spines, the sciatic notch and also to follow the course of the sciatic nerve down the posterior thigh. Very often light pressure applied at the fifth lumbar spine will reveal considerable tenderness in this area.

I wish to make a special point of examining for the presence of fasciitis at this stage of the examination. In association with low back conditions it is most characteristically found in a rather large area extending as low as the sacrum, sometimes as high as the first lumbar vertebrae and out to the loins on either side. When a large fold of skin is grasped between the thumb and finger in a normal person and an attempt made to roll the fold progressively forward there is a feeling of normal tissue tension. The normal skin does not feel thick and boggy, and is not painful as this is done. In the presence of fasciitis the tissue is thick and boggy and there is quite marked pain or tenderness. This is particularly true if the skin is pinched.

Characteristically, there are no reflex changes in the lower extremities in simple unstable fifth lumbar conditions. However, as a patient is seen from time to time the patellar or Achilles reflexes may occasionally be diminished. Unless this reaction occurs consistently it should be of no consequence, particularly if other findings are not indicative of a neurological lesion.

TREATMENT

We have now arrived at the point where we have a patient complaining of constant low backache. The examination revealed tenderness at lumbar five with mild

fasciitis present. The posture is fair, but there is a tendency to stand with slightly increased lumbar lordosis and the erector spinae muscles are not too well developed. We have also found, after carrying out the various tests described under examination above, that the gluteal and thigh fascia are tight.

The x-ray may be normal or show some mild anomalous change such as spinae bifida occulta, asymmetrical facets at lumbar five or posterior displacement of the fifth lumbar vertebrae on the first sacral. Theodore Willis, however, believes that this anomaly is an optical illusion. We will consider that we are dealing in this case with a so-called unstable fifth lumbar vertebrae.[10]

We will place this patient on a program of therapy, that for simplicity in discussion will be the same for every case of this type, but which can be varied to suit individual requirements. The treatment is outlined as follows—

1. General therapy
   (a) general toning up
   (b) lumbar belt
   (c) corrective shoes
   (d) see patient frequently
2. Physical therapy
   (a) radiant heat
   (b) massage
   (c) exercises
3. Home therapy
   (a) bed boards and mattress
   (b) radiant heat or other forms
   (c) exercises

General Therapy. The weak back must not be considered a simple local problem, for many times there are general conditions which may prolong the disability. The question of adequate sleep in the prevention of fatigue, of the patient's working and living environment and of his general health, all must be considered. Some form of mild sedative or analgesic may be needed for a short period. A change of occupation or duty is sometimes also necessary.

In order to reassure the patient and to check on his progress the physician should see him twice weekly for the first two weeks and at least once a week thereafter. In this way changes in the treatment can be made in accordance with the patient's progress.

Often the question of whether or not to order a lumbar belt must be decided. I think that most chronic cases will benefit by the use of a well fitted belt. This should be made just wide enough to be worn between the iliac crests and the trochanters. The use of a keystone shaped pad (Cooke pad), which is laced to the back of the belt so as to fit in the hollow of the lumbosacrum, is advantageous. There are many varieties of patent belts; however, none of them offer any particular advantages over a simple well made belt, built to lace or buckle in the front, and adjustable to allow for changes in girth.

Corrective shoes may be prescribed for patients with flat feet. These may be of the semi-orthopedic type, with an inner heel wedge of $\frac{1}{8}$ to $\frac{3}{16}$ inch and a scaphoid or long arch pad of felt or rubber which may be glued to the inner sole. Particular attention should be paid to the shoes of women complaining of backache because the high heels worn by them contribute to the disorder by throwing the lower extremities and pelvis out of balance.

Physical Therapy. While all elements of the treatment program are important, we will of necessity find ourselves depending most upon the physical therapist. It is, therefore, important that the technician understand thoroughly what is expected of him, and that it is not simply a matter of turning on a light and rubbing a patient's back for a few minutes. It is such half-hearted therapy that produces and prolongs a great deal of low back disability.

Radiant heat for twenty minute periods is probably the best form of heat and can be given very easily. The light should be diffusely focused in its reflector so that there are no hot spots to burn the patient. This should be followed by deep massage for about twenty minutes. In the presence of fasciitis pinch massage to the involved area can be given beginning with short periods of five to ten minutes gradually increasing the time. Such massage is at first quite painful.

The patient is instructed in a routine of graduated exercises and posture improvement which is carried out at home twice daily. It is well to write out instructions, because most patients forget very quickly what they are told. The exercises done at home will be the same as those performed under the direction of the physical therapist. A word of caution in the use of exercises may be mentioned. They should not be done simply to occupy the patient's mind, or simply to give him something to do. We should have a definite end in view, and prescribe our exercises accordingly.

Usually it will be necessary to strengthen both the anterior abdominal and erector spinae groups of muscles, and thus indirectly accomplish pelvic tilting or flexing of the pelvis. Pelvic tilting is necessary to decrease the angle of the sacrum, and to place the sacrum under the lumbar spine, much as a waiter holds a tray over his head with his hand. In this way the spine is better balanced, and the lumbar lordosis is decreased.

We may begin rather gradually by asking the patient to contract the anterior abdominal muscles several times, then repeat the exercise and attempt to tighten the buttocks at the same time. In order to give him some idea of what we mean by decreasing the lumbar curve, he may be asked to stand with his back to a flat wall with heels and head touching the wall. He should then flatten his shoulders and lumbar spine against the wall, and walk away with this posture. It may feel abnormal at first, but as he continues with the program it will gradually feel more natural.

He may then be asked to lie face up on the floor, elevate the arms over the head and take in a deep breath as this is done. Repeat the maneuver several times. The pelvic tilting and the buttock pinching exercises should be repeated on the floor,

because under these conditions the lumbar lordosis is partially obliterated. To these may be added progressively any number of hip flexing, trunk bending, and breathing exercises with or without the use of apparatus such as parallel bars, weights, etc.

Tight fascia will usually be relaxed during a program of this type; however, in some instances more direct therapy may be needed. In the case of tight hamstring and gluteal fascia the patient may lie on a table face up. One or the other leg is then passively flexed at the hip with the knee extended and applying moderate pressure. This maneuver is carried out by the physical therapist several times until it is apparent that the fascia is relaxed. Tight tensor fascia may be relaxed by a simple exercise. The patient stands at right angles to a table, about a foot from the edge. He then adducts the hip nearest the table, keeping his feet in place and supporting himself with his hand on the table. This can be repeated for the opposite side by simply facing about.

Home Therapy. The patient should be instructed to secure a bed board measuring about 3 feet by 5 feet to be inserted between the mattress and the spring of the bed. Two table leaves or boards of similar dimensions will do if nothing else is available. If possible a firm horsehair mattress should also be obtained. I have in a number of cases seen chronic backache disappear as if by magic when a horsehair mattress and boards were substituted for an innerspring mattress.

The exercises which were learned under the guidance of the physical therapist should be continued for twenty-minute periods twice daily, and if possible some form of radiant heat. If this is not available, some other form of heat may be used, such as hot moist packs, hot tub or direct hot shower on the back. An old fashioned electric toaster is a good source of dry heat. Any patient who is overweight or obese should be placed on a strict reducing diet. The importance of removing excess weight cannot be over stressed.

With a course of treatment planned in this manner the patient should very shortly experience some relief, and very soon thereafter more or less complete relief. In some cases, however, active treatment may have to be carried out for three to four months. The patient should expect to continue more or less indefinitely the practice of correct posture, the proper lifting of objects and the exercises. The lumber belt may be discarded after a few months, although many patients will continue to wear it for a certain feeling of security which they get.

CONCLUSIONS

1. Man, as a result of assuming the upright posture, has inherited a potentially weak structure, the lumbosacrum.

2. This area is subject to anomalous changes and is therefore not in equilibrium.

3. This area may be easily overburdened by poor posture, obesity, asthenia, and trauma such as slips or falls resulting in chronic low back disability.

4. Every case should be carefully studied to rule out obvious causes of disability such as protruded intervertebral disc, infections, fracture, arthritis, anomalies, etc.

5. Those cases which remain can be treated with gratifying results by a program such as outlined in this paper.

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CAUSES OF DEATH IN BURNED PATIENTS*

A REPORT OF TWENTY-THREE DEATHS IN 744 BURNED PATIENTS

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THE inspiration to prepare this report is the results obtained in the treatment of 744 consecutive burns with the loss of but twenty-three, 3.1 per cent.

Medical literature shows such diversion of opinion regarding the treatment for burns that the physician who is called upon to treat an occasional burn finds it hard to make a decision as to which treatment to use. Fortunately, small burns heal and the patient recovers irrespective of the treatment used, or as a matter of fact, despite the treatment in many cases. There is no treatment which is ideal, that is, that will in a short period transfer the patient from his serious condition to one of near normalcy. Irrespective of the treatment used, the seriously burned patient has a hard road to travel. Burns covering 10 per cent of the body surface will recover in the vast majority of cases irrespective of what is done for them. Most patients having up to 25 or 30 per cent will recover under difficulties with almost any treatment. When the patient receives a burn of over 30 per cent, it does make a difference what is done. Thirty to 40 per cent is the maximum to recover under many treatments. A recent article in one of our prominent medical journals cited several hundred patients, in which a respectable number up to 30 per cent were saved, a lesser number between 30 and 40 per cent, and of the seventy-two who were burned 40 per cent or more only one recovered. The patient having a serious burn has a better chance of recovering following the use of tannic acid, silver nitrate and drying than from the use of any other treatment which has been brought forward. Three of our patients who had over 80 per cent of their body surfaces burned recovered under the prompt and efficient use of tannic acid and silver nitrate followed by drying. One had over 80 per cent of her skin burned and 60 per cent was still unhealed at the time she was first seen some thirty days after the accident. She was temporarily grafted from her mother and later auto-grafted. The second, a 86 per cent burn was seen six weeks after being burned and skin grafts were placed on the unhealed areas. The third patient received a burn covering over 90 per cent of his body surface and was seen on the twelfth day. His feet, one leg slightly above the ankle, the top of his head, the apices of both axillae and three or four other small scattered areas were not burned. Otherwise his skin was completely burned. He also was temporarily grafted from his father.

These patients were saved because they were under treatment promptly with a treatment that stopped the fluid loss and the fluid shift at once. Experimental work[1] on dogs, who do not weep when burned as humans do, show some interesting facts. It was determined that of the total fluid shift or edema following a burn or injury to one side of the body, 40 per cent occurs during the first hour. It is, therefore, reasonable to assume that a treatment which is effective in stopping this fluid shift at once should save more patients by lessening the time over which the dehydration continues than one which

acts slower. Furthermore, the fluid loss in humans, also, is promptly stopped. We know of no experimental evidence as to just how much of this seepage takes place during the first hour but it undoubtedly would be as great or greater than the 40 per cent shown for the fluid shift.

The burned patient who dies early does so because of dehydration and shock due to the loss of circulating body fluids. Insufficient fluids are left in the circulating blood stream to carry on the bodily functions. The sooner this loss is stopped the less fluid is lost; and if fluids are administered promptly and in sufficient amounts, the patient has a better chance of recovery than if either is delayed.

The application of tannic acid followed by silver nitrate is not the entire treatment. It is just as important to dry the surface at once and to keep it dry throughout treatment. The treatment then is most efficient. Unhealed areas are treated with oxyquinoline sulphate scarlet R gauze.*[2] This gives the quickest and smoothest healing of anything we have ever used.

Statements in the literature show that when tannic acid is injected into muscle or otherwise under the skin, central lobe damage of the liver results. The author does not question this fact. However, the conditions under this treatment are entirely different. Tannic acid solution is applied and immediately, within a very few minutes, the silver nitrate solution is applied. There is a chemical combination between the tannic acid and the fluids on the surface and a second chemical combination between the silver nitrate and the first combination. At once, the tannic acid and the silver nitrate and the surface fluids are fixed in an insoluble, irreversible, undigestible matrix, and nothing is ab-

* Oxyquinoline sulphate scarlet R gauze is made by immersing wide mesh (28 by 24) rolled bandages in the following ointment heated on a water bath.

Rx. Oxyquinoline sulphate..................... gr 10
    Trichlorbutanol (chloretone)............... gr 40
    Scarlet R (National Formulary)........... gr 96
    Oleum Ricini (castor oil)............. ounces 4

sorbed. As a matter of fact, the surface is immediately turned into one that is inocuous, protective and one that prevents the loss of further fluids and the further shift of fluids. The movement of the fluids is the result of the presence of irritants. These irritants have been removed, rendered inactive at once by the treatment.

Medical history of the late 1890's tells that after reports of the usefulness of diphtheria antitoxin were about to be accepted a hue and cry was raised against it because some of the patients after recovery were found to have heart lesions. At once antidiphtheretic serum was blamed. However, cooler heads pointed out that quite the contrary occurred, that not only did the serum save diphtheria patients but that it saved them despite the heart injury. When this was realized antidiphtheretic antitoxin promptly was restored to good favor.

The tannic acid and silver nitrate treatment[3,4,5] requires drying completely, promptly and continuously. When this is carried out, as it can be, there is no infection under the coagulum and there is, therefore, no secondary period of infection with its rise in temperature, high white blood counts and all the things that go with them. However, when drying has not been completely carried out there is, of course, some moisture beneath and further systemic reaction, however to a much less extent than if tannic acid and silver nitrate had not been attempted.

As an indication that the absorption of the surface substances are promptly stopped and further prevented is the fact that under this treatment urinary suppression and albuminuria have never occurred in our experiences provided that grease or oil has not been applied either as a treatment or as the burning agent.

Treatment of a severe burn calls for all the medical knowledge that the surgeon has.

The following is a brief consideration of the twenty-three patients who did not recover out of a total of 744. Not included in this number are two. One was seen on the

third day of his burn in consultation only. This was a man eighty-seven years of age who received a 15 per cent burn of his lower back, the fall into the hot water having been caused probably by an apoplectic stroke. He died the next day.

The second was a girl of twelve years who was likewise seen some distance from Portland and who received a 60 to 70 per cent burn which was treated with tannic acid and silver nitrate solutions without any attempt having been made to dry the surface. Of course there was much infection. When seen in consultation the application of a heated tent for drying was urged but this was never even attempted. The child was sent in in a septic condition at the end of the third week and died within twenty-four hours. She did not receive the tannic acid and silver nitrate and drying treatment.

CASE REPORTS

CASE I. E. D. Y., age two and one-half years, received several small burns of the legs from a stovelid which was placed in the bed when under treatment for whooping cough meningitis from which she suffered. She was seen a few hours after the burn which covered considerably less than 1 per cent of the body surface, of second degree. She died on the third day after the burn of her meningitis as was proven by autopsy. Surely this was not a burn death.

CASE II. J. B., male, forty years, received a 35 per cent burn from a tar explosion. He was under satisfactory treatment by tannic acid and silver nitrate and drying within two hours and was seen the next day. He was in a tent and the surface was dry. Upon arriving at the hospital the patient called his attorney, made his will, and stated that he wanted to die. He fought off everything that was done for him and refused to take fluid. He turned and twisted so that the needle in his vein would not stay in place. He died on the third day.

CASE III. F. H., male, age two years, received a second and third degree fire burn of about 4 per cent of his body surface and was seen two hours later. Grease had been applied. This was removed with ether. The entire area was healed by the eighteenth day except a spot

about ½ inch in diameter which was very superficial. On this day, for some slight indisposition, the mother gave this two-year old child a teaspoonful of bicarbonate of soda and repeated like doses until the child had received eight teaspoonsfuls. When the child had a convulsion a pediatrician was called and the child was rushed to the hospital. He died of an alkalosis on the twenty-first day after the burn.

CASE IV. E. B., male, age eighty-four years, received a small burn of the elbow and of the chest wall neither being more than two by three inches, of second degree, when he attempted to make himself a hot water bottle after suffering a chill at night. Following the burn he went to the hospital where it was determined he had pneumonia from which he died on the sixteenth day.

CASE V. J. C., male, age fifteen months, received a 12 to 15 per cent burn from a boiling coffee percolator, second degree, and two physicians were called. They were apprehensive from the beginning and the author was called to treat the child. No grease had been applied; tannic acid and silver nitrate were applied and the surface kept dry. The burn was all healed except two small areas when the child developed aphthous stomatitis and died on the fourteenth day. There was a questionable history that some other member of the family had a similar condition a short time previously. Aphthous stomatitis in a burned patient determined the outcome.

CASE VI. R. J., female, age seven years, received a third degree fire burn covering 55 per cent of her body surface. The mother telephoned to the family physician who advised the application of vaseline and the sending of the child to the hospital. The area burned was from the hairline in back to the crease of the buttocks, and in front from the mouth to the pubes, laterally from the ears to the middle one-half of the thighs and the arms and forearms also were burned on all surfaces. Despite the fact that an effort was made to remove the vaseline, the surface could not be kept dry even with good nursing and the surface became covered with infection. As soon as possible the surface was prepared and skin was grafted from her father. That afternoon there was a rise in temperature and unknown to the author the child was given sulfapyridine in rather large dosage as this drug had just come on the
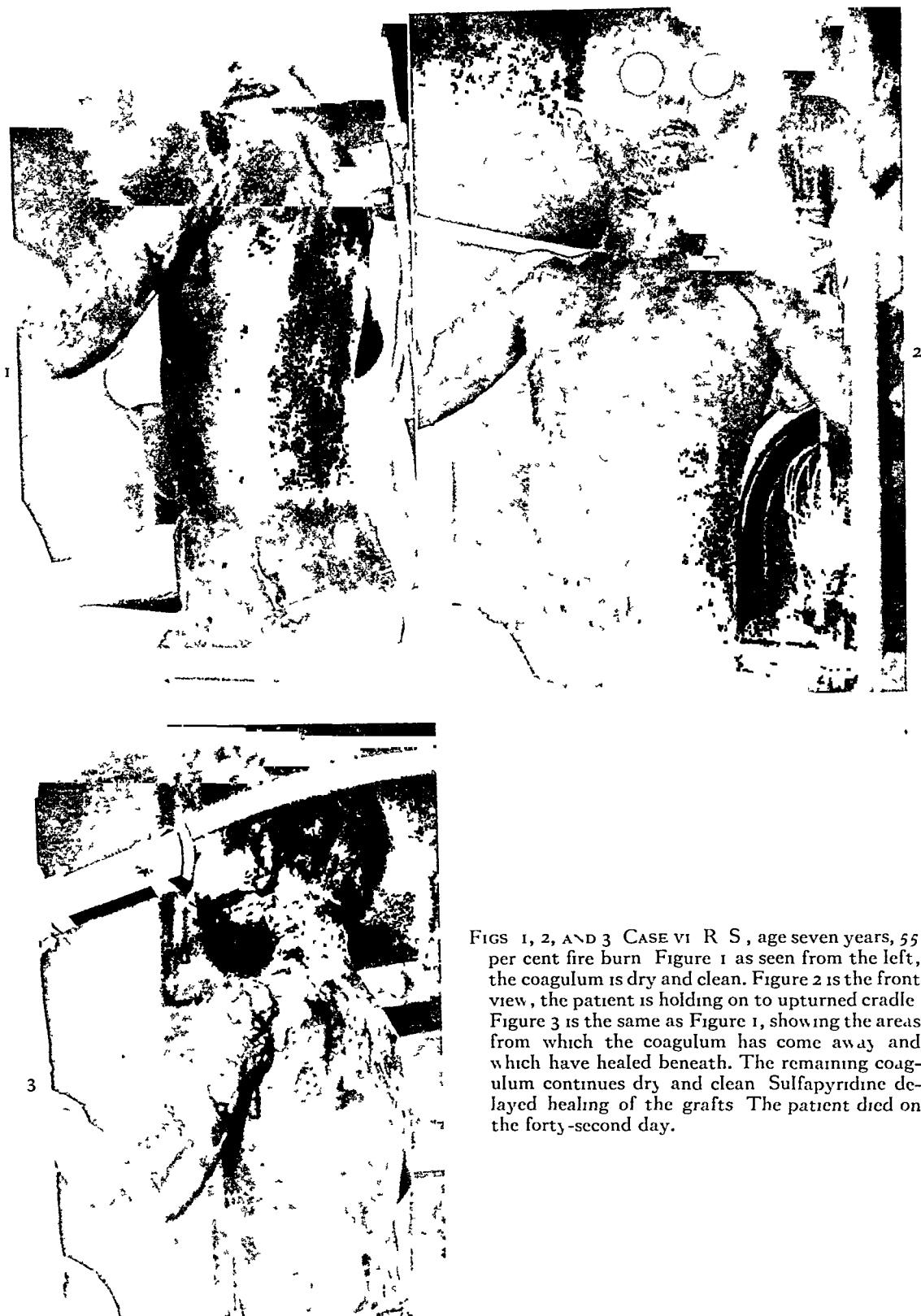
Figs 1, 2, and 3 Case vi R S , age seven years, 55 per cent fire burn Figure 1 as seen from the left, the coagulum is dry and clean. Figure 2 is the front view , the patient is holding on to upturned cradle Figure 3 is the same as Figure 1, showing the areas from which the coagulum has come away and which have healed beneath. The remaining coagulum continues dry and clean Sulfapyridine delayed healing of the grafts The patient died on the forty-second day.

market. When the dressings were changed on the ninth day, it was found that not one graft had taken. It is believed that the sulfapyridine, slowing up healing as it does, took from this child the one chance it had of recovery. She died on the forty-second day.

CASE VII.   P. A. H., female, age three years,

received a 40 per cent second and third degree burn of the body from a hot alkali solution. She was brought to the hospital five hours later after a ride of fifty miles and died three hours after arrival, eight hours after the accident. When the blebs were removed the characteristic red and pink mottling of alkali

	Name		Age	Per Cent	Time Seen	First Aid Treat.	De-gree	Place	Time of Death	Burned by	Cause of Death	Mori-bund or Died of Ex-tra-neous Cause
1	EDY	F	2½	1	2 hr.	TASN	2	City	3 day	Hot stove lid	Meningitis	yes
2	JB	M	40	35	2 hr.	TASN	2-3	City	3 day	Tar	Wanted to die	yes
3	FH	F	2	4	2 hr.	Grease	2-3	City	21 day	Fire	Alkalosis—soda 8 tea-spoonfuls	yes
4	EB	M	84	1	1st day	TASN	2	City	10 day	Water	Pneumonia	yes
5	JC	M	1¼	12-15	2 hr.	TASN	2	City	14 day	Coffee	Aphthous stomatitis	no
6	RJ	F	7	55	2 hr.	Vaseline	3	City	42 day	Fire	Sepsis, sulfapyridine (?)	no
7	PAH	F	3	40	5 hr.	....	2-3	50 miles	8 hr.	Hot Alkali Sol.	Measles, unresolved pneumonia, cyanotic	yes
8	RR	F	2½	50	3 hr.	Soda Bicarb.	3	30 miles	6 hr.	Alkali Fire	Shock when seen	yes
9	MM	F	3½	70	3 hr.	TASN	3	40 miles	6 hr.	Fire	Shock when seen	yes
10	IA	F	35	80	6 hr.	TASN	3	City	11 hr.	Fire	Shock when seen	yes
11	AF	F	7	75	1 hr.	TASN	3	City	2 hr.	Fire	½ gr. morph. sulphate	yes
12	WJ	M	55	5	1 hr.	TASN	2-3	City	11 day	Tar	Diphtheria	yes
13	VT	F	92	95	2 hr.	TASN	2-3	City	7 hr.	Fire	Age and extent, shock	yes
14	RHM	M	77	80	2 hr.	TASN	2-3	City	8 hr.	Tar	Age and extent, shock	yes
15	CTJ	M	26	60	3 hr.	TASN	3	40 miles	5 hr.	Electric	Extent and morph. 3 gr., shock, comp. fracture	yes
16	NP	M	2	55	1 hr.	Grease	2	City	11 day	Water	Sepsis, aphthous sto-matitis, insufficient nursing	no
17	RH	M	4	80	2 hr.	TASN	2-3	City	6 hr.	Fire	Extent, shock when first seen, moved to another hospital	yes
18	JW	F	75	95	1½ hr.	TASN	2-3	City	3½ hr.	Fire	Age and extent, shock and blind	yes
19	G	M	52	25	3 hr.	None	2-3	50 miles	18 hr.	Acetylene Explo-sion	Comp. fracture and burn; secondary shock	no
20	NP	F	23	98	4 hr.	TASN	3	Out of City	6 hr.	Gasoline explo-sion	Extent	yes
21	HW	M	46	80	1 hr.	TASN	2-3	City	5 hr.	Acetylene Explo-sion	Extent and shock	yes
22	JJ	F	5½	70	17 days	TASN	2-3	City	80 days	Fire	Sepsis	no
23	DM	F	30	65	3 hr.	Unguen-tine	2-3	26 miles	67 days	Fire	Sepsis due to lack of nursing care	no

Table tabulates the details of the 23 patients who died. TASN-tannic acid and silver nitrate.

burns was seen. It was also noted when the tannic acid and silver nitrate were applied, that the coagulum took on an opalescent sheen.

CASE IX. M. M., female, three and one-half years, received a 70 per cent third degree fire burn of the body forty miles away and was
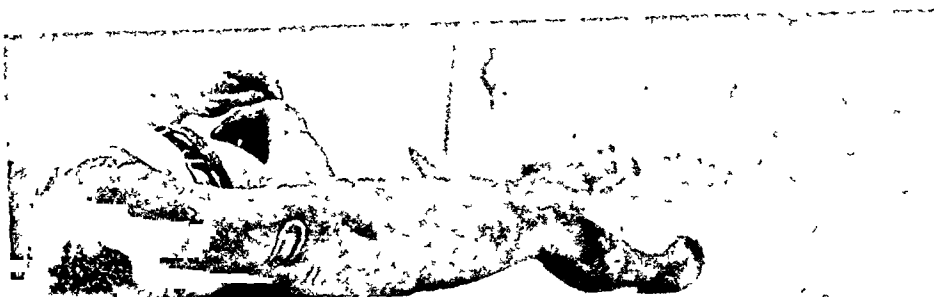
FIG. 4.

FIG. 5.

FIGS. 4 AND 5. CASE XV. C. T. J., age twenty-six years, received a 70 per cent electrical burn with other injuries. Figure 4 shows patient viewed from the right; Figure 5 shows patient viewed from the left. This patient died five hours after injury.

This has been observed in other patients who have been burned by alkali solutions. The history and the autopsy revealed that the child had had measles recently with an unresolved pneumonia present. She was cyanotic when she entered the hospital.

CASE VIII. R. R., female, age two and one-half years, received a 50 per cent, third degree, fire burn three hours before she was seen. She came from about thirty miles out of the city, was in deep shock when she arrived and died six hours after the accident, three hours after entering the hospital. Here again the opalescent sheen was seen. The extent of the burn was increased by the application at home of large quantities of dry bicarbonate of soda. This was noted in the wide extent from which the superficial skin came away, far beyond the areas which were burned by the fire, and which showed the pink and red mottling.

brought to the hospital three hours after the accident. She was in deep shock when seen having received no treatment whatsoever nor fluids, except a narcotic, until she arrived at the hospital. She died three hours after arriving or six hours after having been burned.

CASE X. I. A., female, age thirty-five years, received an 80 per cent, third degree, fire burn of her body. Tannic acid and silver nitrate were applied with drying, but she died eleven hours after the accident being in deep shock when first seen. This burn was very extensive and she was not seen until six hours after the accident. Furthermore, the room in which she was treated could not be made warm nor could the patient be kept warm under the conditions presenting at the place of treatment.

CASE XI. A. F., female, age seven years, received a burn covering 75 per cent of her body surface when her clothes caught fire. She was

seen one hour after the burn. The author arrived at the hospital just as the ambulance drivers were placing her on the bed. When

pital and that she had received ¼ gr. morphine there. She died one hour later. The next morning the physician who had sent her to the

FIG. 6.

FIG. 7.
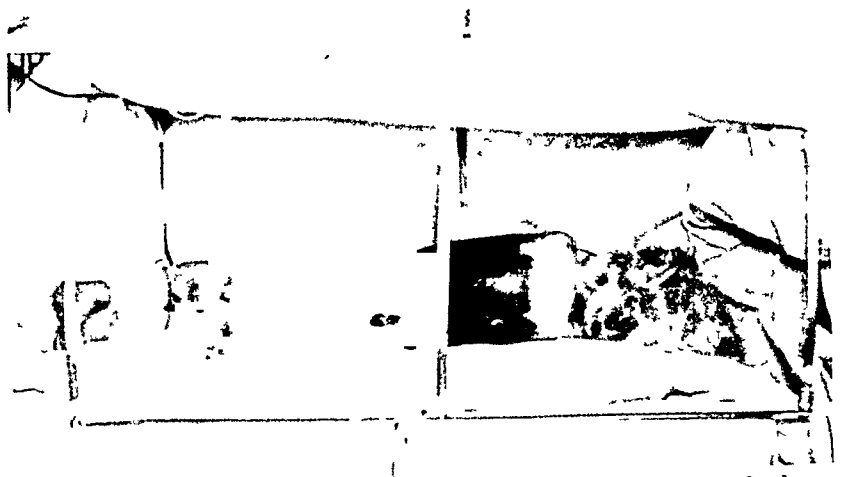
FIGS. 6 AND 7. CASE XVI. N. P., age two years, received a 55 per cent fire burn. The child is shown in an electric lighted cradle. Figure 6 is front view, Figure 7 the back view. This patient died on the eleventh day.
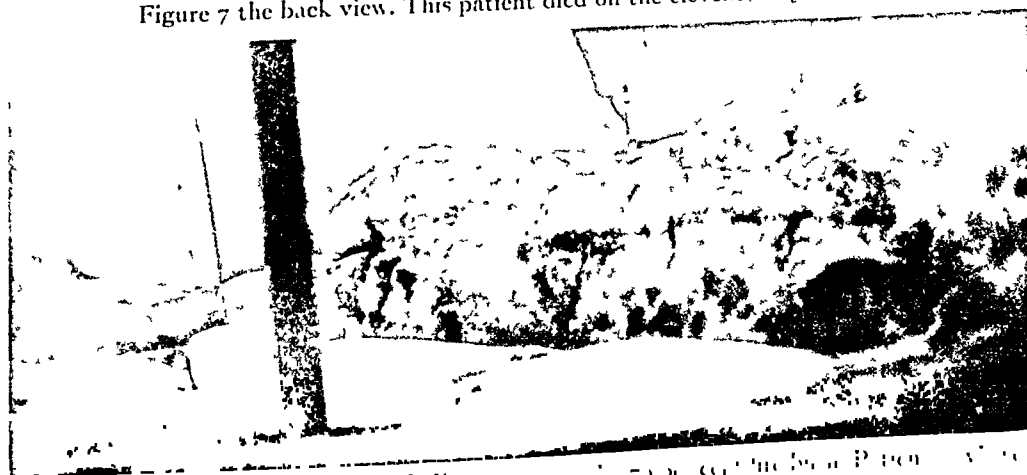
FIG. 8. CASE XXII. J. J., five and one-half years received 7 ¼ per cent fire burn in a P ... from the back.

asked what medication she had received, as her respirations were not good, they stated that they had stopped at the emergency hos-

hospital stated that he had given her ¼ gr. morphine. This child of seven years received ½ gr. of morphine sulphate.

CASE XII.   W. J., male, age fifty-five years, fell, immersing his hand, forearm and arm in a container of hot tar. Two hours were re-

tannic acid and silver nitrate was applied two hours after the burn, fluids were given and the surface dried but the patient died seven hours

FIG. 9.

FIG. 10.

FIGS. 9 AND 10. CASE XXIII. D M., age thirty years, received a 65 per cent fire burn. Figure 9 shows patient as viewed from the right; Figure 10 shows patient as viewed from the left. This patient died on the sixty-seventh day.

quired by three physicians to remove the tar so that the surface could be tanned. A satisfactory tan was obtained and he was placed in bed with a cradle and the surface satisfactorily dried. On the eighth day one of the attendants developed diphtheria. All patients had their throats cultured. This patient, however, refused to allow the intern to take a swab and when the resident attempted to obtain same he knocked him down with a blow of his fist. He developed diphtheria and despite treatment died on the eleventh day.

CASE XIII.   V. T, female, age ninety-two years, received a fire burn which covered her body except the soles of her feet and that portion of her head which was covered by hair and the domes of each axillae. Otherwise the entire body was seared. An application of

after the accident of the extent of her burn and her age.

CASE XIV.   R. H. M., male, age seventy-seven years, received an 80 per cent burn from tar explosion. He was seen two hours after the accident and succumbed six hours later. The surface was properly tanned and dried. The cause of death was the extent of the burn in an aged man. His sister was killed outright in the explosion. When the patient learned this fact he lost the will to live.

CASE XV.   C. T. J., male, age twenty-six years, received a burn covering over 70 per cent of his body surface three hours before he entered the hospital and came forty miles by automobile. On the trip to the hospital it was necessary for the physician to administer 1 gr. doses of morphine sulphate on three occasions

in order to give any comfort at all. This was an electric burn; the patient came in contact with 115,000 volts at 7½ amperes, fell onto a network of high power wires, then to the ground about twenty feet below. All the tissues were burned below a line roughly diagonally from the left hip to the right side of the neck, back and front. The tissues were so badly burned that a number of bones presented at the surface. He had a large contusion at the top of the head and a compound comminuted fracture of the inferior maxillary with widespread lacerations of the superficial tissues. His breathing was depressed and he died two hours after arriving at the hospital.

CASE XVI. N. P., *male, age twenty-two* months, received a hot water burn covering 55 per cent of his body surface. He was seen at the hospital one hour after the accident, covered with grease. This was removed and the area was then properly tanned and dried. Despite everything that could be done, he developed sepsis and aphthous stomatitis and died on the eleventh day. The primary application of any greasy preparation definitely increases the seriousness of any burn. The unavailability of nurses added to the difficulty.

CASE XVII. R. H., male, age four years, received a second and third degree fire burn covering 80 per cent of his body surface. He was taken to a hospital where the surface was properly tanned except the face. He came under our care two hours after the accident having received no anti-shock treatment other than the local applications. Fluids were started intravenously and by mouth but could not be given in large enough quantity to overcome the dehydration and the delay in starting fluids. Upon entering the hospital his hemoglobin was 117 per cent and his red blood count 6,5000,000 and three hours later the hemoglobin was 140 per cent. Add 10 to 15 per cent for age. He died four hours after entering the second hospital. This patient should have had fluids and shock overcome before he was moved from the first to the second hospital. This, at least, would have given him a chance for recovery.

CASE XVIII. J. W., *female, age seventy-five years,* received a 95 per cent, second and third degree burn when in her blind condition she set her clothes on fire from an open fireplace. She was seen one and one-half hours after the accident and although satisfactorily tanned died two hours later.

CASE XIX. V. G., male, age fifty-five years was burned fifty miles from Portland by the explosion of acetylene. *In addition to the concussion* he had a burn covering 25 per cent of his body surface and a compound fracture of the left femur. He came by automobile fifty miles and arrived in shock. The burned area was tanned, he was given fluids and was coming out of shock when the fracture was treated by an orthopedist. A plaster paris cast was applied covering the entire left leg and thigh and the left buttock, fully 30 per cent of the body surface. This large, cold, wet application to a patient not completely out of shock caused him to relapse into shock from which he could *not be brought out. He died eighteen hours* after the accident. Had the treatment of the fracture been delayed another twelve hours, the patient might have had a chance to survive.

CASE XX. N. P., female, age twenty-three years, received third degree burns over the entire body except the top of her head. She died six hours after the accident less than two hours after coming under treatment.

CASE XXI. H. W., male, age forty-six years received a second and third degree burn covering 80 per cent of his body surface from the explosion of acetylene. He was seen at the hospital one hour later and the surface was tanned and dry. The large extent of the burn together with the injury due to concussion determined the outcome. He died five hours after the accident.

CASE XXII. J. J., female, age five and one-half years, received a fire burn covering 70 per cent of the body. She was seen on the seventeenth day and the coagulum was wet and had much secretion beneath it. Every effort was made to remove the coagulum as early as possible *in order to skin graft the* surface but she succumbed on the eightieth day. In order to keep a burned area dry, drying *must be started at the beginning.*

CASE XXIII. D. M., female, age thirty years, received a 65 per cent fire burn. She arrived at the hospital three hours after the accident, after a ride of twenty-five miles, covered with unguentine. An honest effort was made to remove this application. It was impossible at any one time to get three nurses on the case. A serious burn requires full nursing attention for twenty-four hours a day; one nurse of eight hours cannot overcome the unfavorable conditions which develop during

the remaining sixteen. It is believed that had this patient had three nurses she might have recovered. She was skin grafted from her brother and these had taken nicely at the time of her death.

Of the twenty-three deaths; twelve, or 52 per cent, died in from two to eleven hours after having been burned and thirteen, 56.5 per cent, in the first twenty-four hours. These are the patients who were overwhelmed by their burns. No patients died on the second day. Eight died on the third to the forty-second day; of these, two on the third day, none on the fourth to the ninth day, three on the tenth and eleventh days, three from the twelfth to the forty-second day. Two died on the sixty-seventh and eightieth days, respectively.

The following died of conditions not related to the burn: Too much soda, too much morphine, will to die, pneumonia, meningitis, measles, diphtheria and compound fracture.

It is our belief that in only six was there a chance to save the patients when they were first seen, excepting, of course, those who died of extraneous conditions. The few that died of sepsis arrived at the hospital covered with grease or oil of some kind. These applications always increase the risk to the burned patient. Only one died of the many who came under our attention after the second day, on the seventeenth.

Causes of burns were: Fire caused eleven, 47 per cent, hot stovelids one, hot water or other hot liquid five, electricity one, tar three, and acetylene explosions two.

The ages were: Eleven, 47.8 per cent, who died were below seven years of age. There were no deaths between eight and twenty-two inclusive, eight were between twenty-three and seventy-four years and four were between seventy-five and ninety-two years.

As to the per cent of body surface burned:

Per Cent of Burn	No.	Cause of Death
1	2	Meningitis; pneumonia
2–5	2	Diphtheria; alkalosis
5–10	none	
11–20	1	Aphthous stomatitis
21–30	1	Concussion, fracture and cast
31–40	2	Wanted to die; measles, unresolved pneumonia
41–50	1	Shock
51–60	2	Sepsis—sulfapyridine; sepsis—aphthous stomatitis
61–70	4	Shock; extent; sepsis; lack of nursing care
71–80	5	Extent and concussion; moved without shock treatment; age and extent; too much morphine; shock
81–90	none	
91–100	3	Age and extent; age and extent; age and extent

Under the tannic acid and silver nitrate treatment with drying in a series of 744 consecutive burns, twenty-three have been lost, or 3.1 per cent. Surely a treatment which gives such a low death rate deserves a high place in the treatment of burns.*

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*Since the above was presented for publication, thirty-four additional burned patients have been treated with the death of one, a total of 778 cases with twenty-four deaths, 3.1 per cent. The latter was of a sixty-three year old woman with a 65 per cent hot water burn contracted while in a bath tub. Death took place in fifteen hours.

CONTIGUOUS SKIN FLAPS FOR WOUNDS OF THE EXTREMITIES

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THE restoration of the wounded soldier to a functioning state in the shortest period of time is the goal of all surgical officers.

the need for penicillin and the better results therefrom. Concurrently the ideas of Colonel E. W. Churchill[1] and Major Champ Lyons[2] on the relationship of the
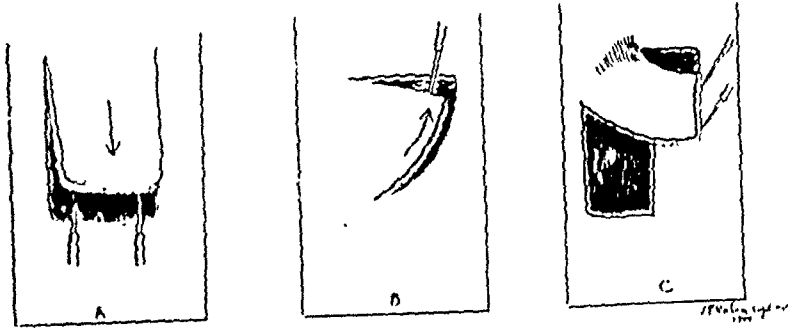
FIG. 1. Three general principles of the contiguous skin flap technic: A demonstrates advancement; B demonstrates rotation; C demonstrates transposition.

In the base sectors of overseas theatres, the secondary closure of wounds is the bulk of war surgery. The majority of wounds, since skin loss is minimal, can be closed by adequate undermining and suturing of the edges. However, there are avulsed wounds in which the loss of skin and deep tissue makes the closure seem impossible except by skin grafting. But there is another alternative to the skin graft, namely, the contiguous skin flap. This method is simply the mobilization of skin adjacent or contiguous to a wound by the use of planned incisions which permit the contiguous skin to cover the defect after advancement, rotation or transportation of the skin flap. (Fig. 1.)

The increased use of contiguous skin flap methods of closure has grown in our practice largely because of the application of penicillin protection and multiple blood transfusions for improved wound healing. Contiguous skin flaps require extensive undermining and opening of large areas of tissue to bacterial invasion, therefore,

normal blood picture and wound healing have been applied with diligence so that every wound, extensive or likely to be slow in healing, received multiple transfusions until the blood volume and hematocrit stayed normal.

Clarkson[3] has helped to renew interest in problems of extensive wound closures and has described methods of suturing after undermining and rotation.

Textbooks on surgery contain uninteresting descriptions of the technic of skin flaps, with two few and inadequate sketches. This paper attempts to summarize, with the aid of drawings, photographs and charts, our experiences with contiguous skin flaps for wounds of the extremities.

The indications for the use of this technic apply to wounds which require new skin tissue which: (1) Will cover exposed bone, tendon or deep irregular muscle defects; (2) will not adhere to underlying muscle when fascia is missing, and (3) will not contract.

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In short, wherever a skin cover containing fat is desired, the contiguous skin flap has a place. Alternatives would be tube or flap grafts.

Contiguous skin flaps have their limitations. Where the skin loss is extensive, the technic becomes impossible because skin manipulation beyond a certain point will shut off blood supply either by tension or direct severance. The flaps are best used where the skin is lax, as on the abdomen, back and face, and less easily utilized on the arms, forearms, thighs and legs. The lateral aspects of the thigh and legs do not readily lend themselves to the procedure. It is almost impossible to use the technic on the soles of the feet, very difficult on the palms of the hand.

GENERAL TECHNIC

Granulation tissue is excised completely and a fresh skin margin prepared. Planned new incisions are made and then the flaps are undermined. The flaps must contain all layers of fat down to deep fascia. Undermining is continued until the wound can be closed by bringing the edges together. The question arising immediately is how much undermining and how much stretching one can do before there is loss of viability. Figures quoted by Clarkson[3] have, on the whole, coincided with our series. "In the leg, below the level of the bellies of the calf muscles, 4 cm. is safe. As one goes higher in the limb, the figures become 7 and 8 cm. In the arm and upper forearm, 8 to 10 cm. can be undermined."

Fairly large defects can be closed, depending upon the location and the direction of the wound. In the extremities, a wound running transversely is more difficult to close than one in a longitudinal direction. Thus, a transverse wound 3 cm. wide, on the lateral aspect of the leg will require extensive undermining. A similar wound on the lateral aspect of the thigh will also present difficulties. But, a defect 25 by 14 cm. in a longitudinal direction up and down the thigh will close easily. No invariable rule can be laid down. A study of our cases

in Table 1 will give some idea of the sizes of the wounds closed. We know of no method of determining the limits of safe closure other than the use of clinical judgment.
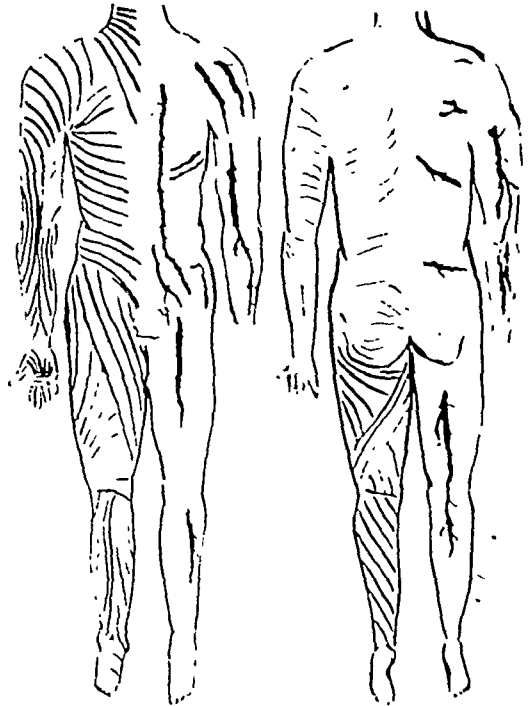
Fig. 2. Illustration of Langer's lines and of principal blood vessels supplying skin areas.

Buried non-absorbable sutures are not employed. Deep sutures, to take the tension off the edges, are of plain catgut No. 00, and, where delicate flaps are used, of No. 0000 on atraumatic needles.

Plaster of Paris splints are applied after operation and retained until we remove the superficial cotton sutures, usually about the tenth day.

To facilitate the description and planning of the surgery, we have made use of the standard ways of transforming irregular wounds into geometric designs, such as triangles and rectangles, and have planned the closures to give figures H, Y, T, Z, etc. Planned incisions wherever possible should be made along Langers lines. (Fig. 2.) The study of Langers lines or the natural skin lines will repay the surgeon with finer skin scars and more rapid healing.

TABLE I
CASE SUMMARIES—CONTIGUOUS FLAP CLOSURES

Case No.	Anatomical Site	Size cm.	Age of Wounds in Days	Direction of Wound	Type of Closure	Remarks
1	Buttock	30 by 15½	28	Transverse	Rotation T Plastic	Uneventful
2	Buttock	15 by 11	44	Transverse	Rotation T Plastic	Uneventful
3	Buttock	15 by 10	27	Transverse	Rotation T Plastic	Wound closed with deep layer of buried cotton sutures. Wound edge broke down and yielded Staph. albus, B. Pyocyaneus and C. hoffmani. Drainage persisted until wound edge was excised and all cotton removed. Resuturing was followed by healing.
4	Buttock and hip	12 by 10	36	Transverse	Rotation T Plastic	Marked muscle loss Necrosis about a few sutures. Upon walking, a small area over the hip broke down. Hem. staph found on culture. Small split skin graft placed over the defect with healing.
5	Buttock and hip	24 by 10	11	Longitudinal	Rotation T Plastic	Marked loss of muscle substance. Rotation followed by cellulitis and then abscess formation. Culture yielded hem. strep. and pyocyaneus. Under wet dressing and dependent drainage wound healed.
6	Buttock and thigh post.	10 by 7	13	Longitudinal	Rotation T Plastic	Uneventful
7	Thigh	28 by 11	12	Longitudinal	Advancement	Slight suture necrosis. Then uneventful healing.
8	Hip and thigh	20 by 8	...	Longitudinal	Advancement	Uneventful
9	Thigh post.	6 by 14	60	Transverse	Advancement U Plastic	Uneventful
10	Thigh post. just above popliteal space	4 by 10	13	Transverse	Advancement U Plastic	Flap was delayed twice because of size of flap and color changes at time of raising. After wound closed lateral margin broke down. Four days later margin excised, resutured and healed.
11	Thigh post. middle ⅓	6 by 12	53	Transverse	Advancement U Plastic	Uneventful
12	Leg post.	8 by 5	9	Oblique	Advancement	Uneventful
13	Leg post.	12 by 5	24	Transverse chevron shape	Advancement Y Plastic	Uneventful
14	Leg medial	18 by 5	51	Longitudinal	Advancement Y Plastic	Uneventful
15	Leg lateral	10 by 5	...	Longitudinal	Advancement	Uneventful
16	Leg posterior	9 by 4	...	Longitudinal	Advancement	Uneventful
17	Leg lateral	3 by 5	24	Transverse	Rotation T Plastic	Uneventful. Marked edema persisted for a month after patient began to walk. Subsided after two months.

TABLE I (Continued)

Case No.	Anatomical Site	Size cm.	Age of Wounds in Days	Direction of Wound	Type of Closure	Remarks
18	Leg anteriorly upper ⅓ tibia exposed	2 by 4	57	Transverse	Transposition	Flap raised and delayed two times. Part of distal edge necrotized due to ischemia. Flap transposed at the third operation with final healing.
19	Leg ant. upper ⅓ tibia exposed	4 by 4	245	Circular	Transposition	Flap delayed two times and then transposed. Site of donor flap split-skin grafted.
20	Leg ant. middle ⅓ tibia exposed	7 by 5	68	Longitudinal	Transposition	Flap delayed two times. Marked cellulitis followed first raising, leading to frank pus. Culture grew Staphaureus, Cacnes and paracolon. Wet dressing cleared infection. Three weeks elapsed between first and second delaying stages. Site of donor flap covered with a split-skin graft.
21	Leg ant. tibia exposed	10 by 3	25	Transverse	Rotation and Advancement Y Plastic	Suture necrosis cleared by wet dressings.
22	Leg lateral to knee	4 by 3	73	Transverse	Advancement Y Plastic	Wound broken down about sutures. Cultures yielded Staph hem. Healed under wet dressings.
23	Leg lateral aspect	11 by 5	25	Longitudinal	Advancement Y Plastic Relaxing Incisions	Superficial suture necrosis healed under wet dressings. Edema of the leg, persistent when patient began to walk.
24	Leg post. ⅓ lower exposed infected tendon	3 by 8	25	Transverse	Advancement	Flap was raised and delayed. It was followed by marked infection. Culture grew Clostridium Chauvoei, Anaerobic Strep, and Staphalbus and B. Pyocyaneus Six cm. of the flap necrotized. The tendon slough was severe. After three weeks of azochloramid dressings a split skin graft was laid over the granulation wound with complete healing.
25	Leg post. lower ⅓ exposed Achilles tendon	6 by 6	32	Transverse	Transposition	Flap was delayed three times. Circulation remained very poor. The distal end of the flap continued to slough each time. It became apparent that the defect could not be closed by transposition a flap graft was raised from the opposite thigh
26	Leg lateral aspect	3 by 7	4	Transverse	Advancement H Plastic	Superficial suture necrosis. Healed with wet dressings.
27	Leg post. aspect mid ⅓	6 by 10	23	Transverse	Advancement H Plastic	Distal and proximal flaps delayed. Distal end of proximal flap became necrotic and purulent. Culture grew Straph. aureus and B. proteus. Azochloramid dressings for two weeks. Granulations filled the marked gastrocnemius defects and a split-skin graft was applied two weeks later.

TABLE I (*Continued*)

Case No.	Anatomical Site	Size cm.	Age of Wounds in Days	Direction of Wound	Type of Closure	Remarks
28	Post. axillary fold contracted scar broken down	14 by 2	75	Longitudinal	"z" Plastic	Flaps delayed. Sutured into position six days later.
29	Post. axillary fold contracted scar broken down	15 by 1	55	Longitudinal	"z" Plastic	Few suture necrosis areas. Healed with good function.
30	Antecubital space open wound	14 by 4	26	Longitudinal	"z" Plastic	One stage. Hem. strep. infection followed. Wound opened, wet dressings applied. Wound resutured with complete healing.
31	Antecubital space contracted broken down wound	10 by 2½	120	Longitudinal	"z" Plastic	One stage. Uneventful
32	Antecubital space contracted broken down wound	18 by 2	63	Longitudinal	"z" Plastic	One stage. Distal tip became necrotic but healing under wet dressing gave a good functional result.
33	Antecubital space contracted broken down wound	12 by 2½	65	Longitudinal	"z" Plastic	One stage. Uneventful.
34	Antecubital space contracted broken down wound	5 by 1	60	Longitudinal	"z" Plastic	One stage. Uneventful
35	Antecubital space open wound	12 by 4	16	Longitudinal	"z" Plastic	Two-stage delayed procedure. Distal tip became necrotic after 2nd stage. Extensive undermining had been necessary. Under wet dressings the defect healed in two weeks with good function.
36	Antecubital space open wound	14 by 4½	7	Longitudinal	"z" Plastic	Two stage delayed procedure. Both flaps became cyanotic after transposition with a superficial corneum peeling. Healed completely under wet dressings.
37	Palm of hand. Contracted scar across distal crease	3 by 1½	37	Longitudinal	"z" Plastic	Uneventful
38	Groin open cont. wound following old closure	6 by 3	120	Longitudinal	"z" Plastic	One stage. Flaps were of poor texture and broke down upon walking. Area was completely excised and split skin graft applied.
39	Groin cont. scar	5 by 3	110	Longitudinal	"z" Plastic	One stage. Wound broke down. In purulent discharge, culture grew pyocyaneus, staph albus hem, and corynbacterium exerose. After a week of wet dressings; a split skin graft was applied with complete take and good function.
40	Popliteal space open wound	14 by 5	23	Longitudinal	Multiple Plastic	Superficial suture necrosis which healed under wet dressins.
41	Popliteal space open wound	11 by 3	21	Longitudinal	"z" Plastic	Two stage delayed flap procedure. Attempted closure, with one stage flap became cynotic. At second stage a paravertebral block was given after the procedure. Some distal edge necrosis but under wet dressings, healed.

TABLE 1 (Continued)

Case No.	Anatomical Site	Size cm.	Age of Wounds in Days	Direction of Wound	Type of Closure	Remarks
42	Popliteal space contracted broken down wound	12 by 1½	.110	Longitudinal	"z" Plastic	One-stage. Lumbar paravertebral block done after procedure. Distal flap tip became necrotic but healed with wet dressings.
43	Popliteal space contracted broken down wound	11 by 2	140	Longitudinal	"z" Plastic	Two-stage procedure. Lumbar paravertebral block performed at time of second operation. Uneventful healing.
44	Popliteal space contracted broken down wound	12 by 3	109	Longitudinal	"z" Plastic	One-stage procedure. Flaps broke down. Culture grew staph albus and pyocyaneus. Azochloramid dressing cleared infection and two weeks later a split skin graft was applied. Complete take with good result.
45	Arm medial aspect middle ⅓	4 by 3	39	Transverse	Rotation T Plastic	Uneventful closure.
46	Forearm, lower ⅓	15 by 6	29	Longitudinal	Advancement	Ulna exposed. Despit marked undermining, wound could not be safely closed. Bone was covered and wound partially sutured. Split-skin graft week later completed the closure.
47	Forearm	8 by 4	23	Longitudinal	Advancement	Uneventful closure
48	Wrist	4 by 5	7	Transverse	Advancement and rotation Y Plastic	Uneventful closure
49	Ankle	3 by 4	191	Longitudinal	Rotation T Plastic	Delayed procedure. After closure at the 2nd stage, wound broke down with a marked hemolytic strep infection. The flaps became necrotic and sloughed. The wound was eventually closed by a flap graft from the opposite thigh.
50	Foot Planter and lateral aspects	6 by 1½	7	Longitudinal	Advancement	Uneventful closure.

The following diagrams and final photographs illustrate the more specific and fine details of technique: (Figs. 3 to 12.)

COMMENTS

Circulation. No flap can exist without its blood supply, arterial and venous. Undermining and elevation of a flap destroy the vascular supply, and require that new channels be formed of sufficient degree to maintain circulation. To avoid ischemia we stress the importance of a thick flap. Figure 14 illustrates large blood vessels coursing through the fatty areolar tissue under the corium. These vessels send small branches up in straight lines to form anastomosing plexuses in the corium. To insure complete blood supply, one must include in the flap all layers of tissue, especially all of the fat down to the fascia.

Every surgeon doing wound closures must familiarize himself with the direction of blood vessels, as shown in Figure 2. Illustrations can be found in every standard textbook. If possible, each flap should include a fair sized vessel. At times, however, the position of the flaps will necessitate cutting across main sources of blood supply. To maintain the viability of the flap, we employ the technique of "delaying," which

uses the principle of a gradual, rather than a sudden, reduction of blood supply. In our problem, the flap, after being outlined

in its former position. The cutting of blood supply from the edges and from the bottom will force dilatation and enlargement of
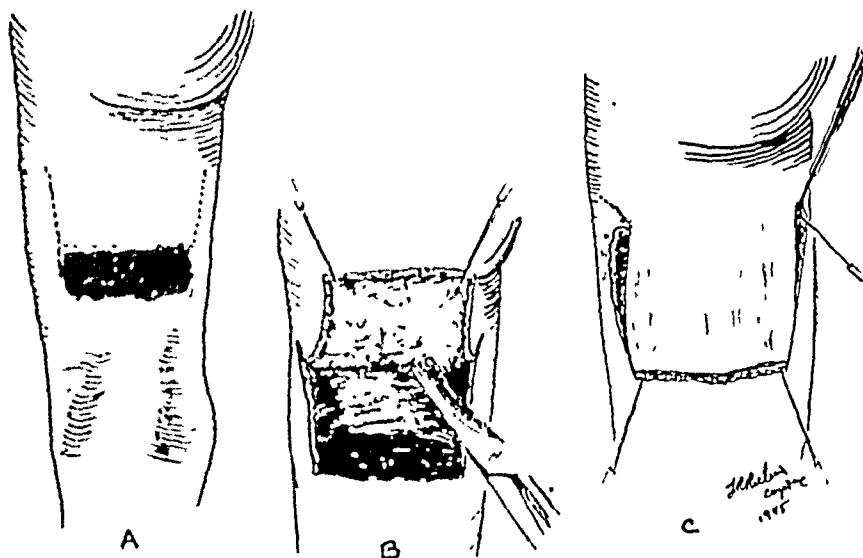
FIG. 3A, B and C.

FIG. 3D.

FIG. 3. A to D, advancement single flap U closure for rectangular wound. Location and direction: Posterior aspect of thigh, transverse direction. Size: 14 cm. by 6 cm. Deep hamstring muscle loss. Proximal flap included all layers of fat down to fascia. Advancement with No. 00 plain catgut buried to relieve edge tension. Tension and puckering at proximal part of the flap was relieved by the removal of Burow's triangles.

through the skin, subcutaneous tissue and fat, is completely lifted from its bed, only to be replaced immediately and resutured

blood vessels at the base. These vessels array themselves longitudinally and so enhance circulation for the eventual trans-

fer. This takes a minimal time of five to seven days. Even if some sloughing were to develop later, it would be less than if the

be lost if a failure were to occur and other procedures started.

The choice of anesthesia is most impor-
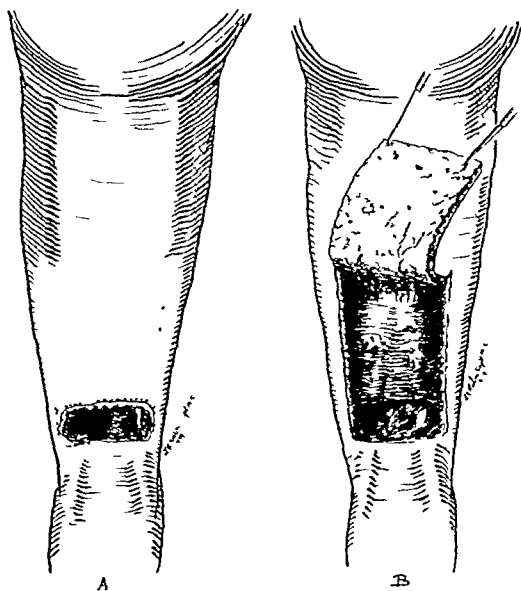
Fig. 4A and B.
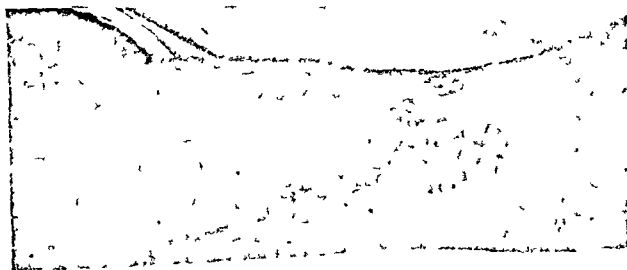
Fig. 4C.

Fig. 4. A to C, advancement single flap ⋃ closure for rectangular wound. Location and direction: Suprapopliteal space, transverse direction. Size: 5 cm. by 9 cm. Illustration demonstrates a suprapopliteal wound with exposure of tendons. After a conversion to a rectangular shape, a 15 cm. proximal flap was raised and delayed. Seven days later, flap was elevated again and wound closed. A narrow margin laterally necrotized, and to avoid prolonged healing, this necrotic edge was excised and easily closed. Wound healed uneventfully. Total time for repair was twenty days.

flap were not raised. If, at the end of seven days, the flap is raised again and one is still worried about the circulation, the same procedure should be repeated. This may necessitate several stage operations. However, the total time required for multiple stage operations is much less than it would

tant from the view point of circulation. Local anesthesia, even without adrenalin, should never be used. Adrenalin is definitely contraindicated because of vasoconscriction. The presence of novocaine in the tissues gives us a mechanical barrier of fluid, compressing the capillaries. Thus we
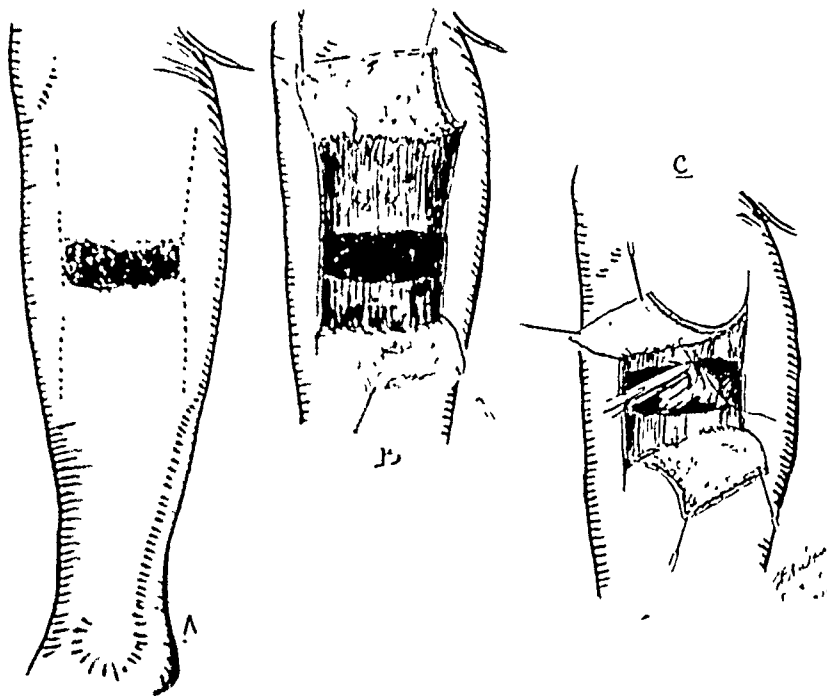
FIG. 5A to C.

FIG. 5D.

FIG. 5. A to D, advancement two flap II closure for rectangular wound. Location and direction: Lateral aspect of leg, transverse direction. Size: 3 cm. by 7 cm. Marked muscle loss was present. Wound edge was converted to a rectangle. New incisions down to fascia were made and two flaps proximal and distal to the wound were raised. Proximal flap was 7 cm. long and distal was 6 cm. long. Flaps were delayed. Six days later both flaps were elevated and advanced. No. oo plain catgut was used for the deep advancing sutures. There was superficial necrosis at the edges of the flaps, but after the sutures were removed on the twelfth day, the necrotic areas healed rapidly under wet dressings.

get constriction, despite the vasodilating action of novocaine without adrenalin. Wherever possible, brachial block for the

dilation during, and for a significant period after the operation. The time immediately after the elevation of the flap is the critical
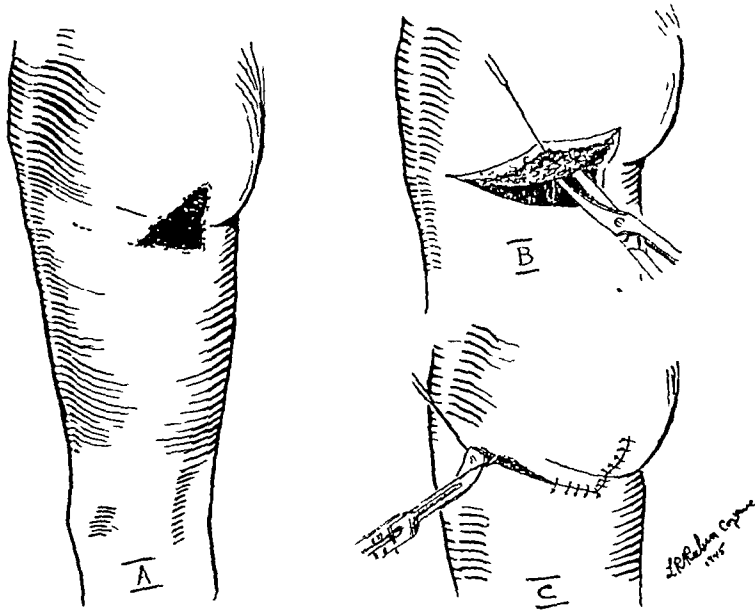
FIG. 6A TO C.
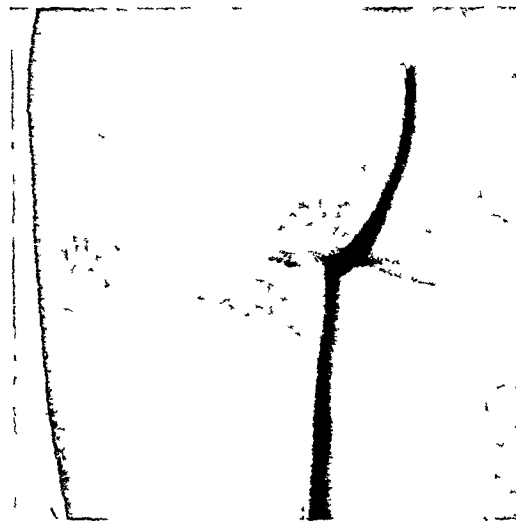
FIG. 6D.

FIG. 6, A TO D, rotation L closure for triangular defect Location and direction: Posterior medial aspect of buttock and thigh, longitudinal direction Size: 7 cm by 10 cm. The loss of tissue included the hamstring and gluteals Because of the proximity of the wound to the rectum, a one-sided flap was raised laterally. The flap was very thick and since the circulation was adequate with the thick layer of accompanying fat, the defect was closed in one stage by rotation. Tension and puckering at the lateral angle was removed by excising a triangle known as a Burow's triangle.

arms and spinal anesthesia for the lower extremities are the choice. These are preferred because they ensure maximum vaso-

period. It is then that the circulation is in need of the greatest possible aid and must be watched.

Yet another factor to be considered is the presence of vasomotor spasm encountered in certain individuals. Some people

lumbar. If an adequate increase of circulation follows, without skin anesthesia, the effect is prolonged by the injection of 2 cc.

Fig. 7A and B.

Fig. 7C.
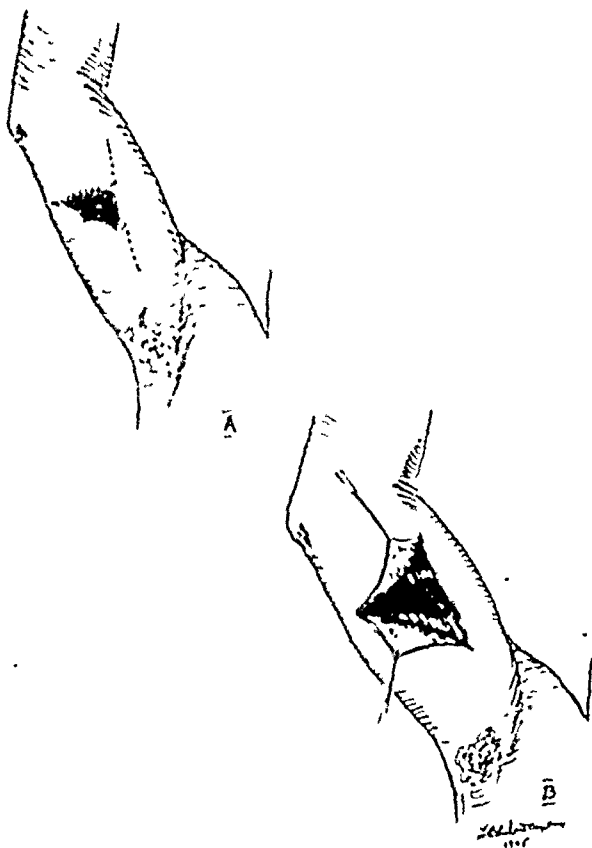
Fig. 7. A to C, rotation two flap closure for triangular wound. Location and direction: Medial aspect of mid-arm, transverse direction. Size: 4 cm. by 3 cm. Two previous unsuccessful attempts at simple closure. Two flaps raised, extensive undermining, and flaps then rotated and closed in one stage. Two Burow's triangles were removed at both ends of the horizontal bar of the t to allow for puckering (x in figure c).
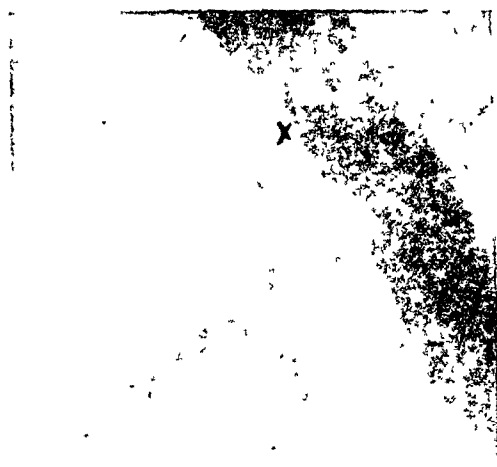
have a high vascular tone and are sensitive to the vasoconstrictive effects of cold, pain and trauma. As a result of the original trauma, these individuals frequently exhibit either localized or generalized form of pallor, coldness, cyanosia, or excessive sweating. The additional surgical injury of extensive flap lifting may be followed by a serious increase of vascular constriction, so serious as to cause necrosis in places where least expected. Excessive vasoconstriction is often seen in the legs.

To deal with this condition we have made use of the paravertebral sympathetic block. Five cc. of 2 per cent novocaine is injected into each of the paravertebral areas, usually the second, third and fourth

of 95 per cent alcohol through each needle. We do not use alcohol in the stellate blocks of the upper extremity in order to avoid the possibility of a permanent Horner's syndrome and because repetition of a stellate block is easy and practically painless.

The question of heat in circulation increase should be briefly discussed. The application of heat increases circulation. The recent work has shown, however, that heat applied directly to a part with a deficient circulation, increases the metabolic needs of the part far greater than it increases the blood supply. In short, the direct heating of an ischemic area favors necrosis. Heat is beneficial nevertheless, when applied to the trunk of the body, so as
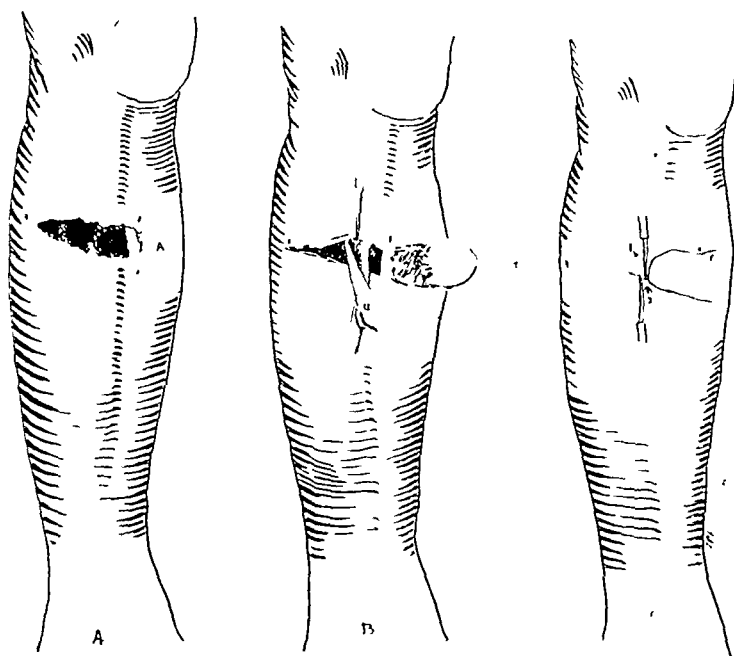
FIG. 8A to C.
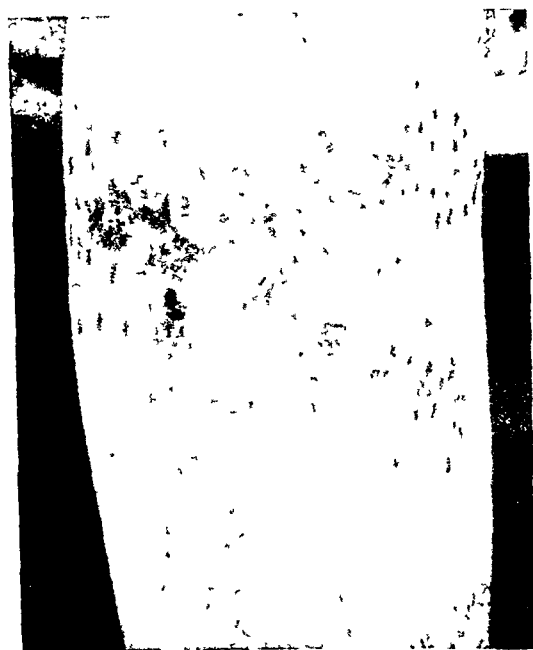
FIG. 8D.

FIG. 8. A to D, combined rotation and advancement ι closure for triangular wound with exposed tibia. Location and direction: Middle third of leg over tibia, transverse direction. Size: 3 cm. by 10 cm. Tibia edge was exposed and there was a loss of peroneal muscle tissue. After extensive undermining, medially directed incisions elevated a thick flap which was advanced laterally to cover bone defect. Wound was then closed by rotating the proximal and distal flaps. The moderate amount of tension present accounted for the superficial skin necrosis which healed after the sutures were removed.
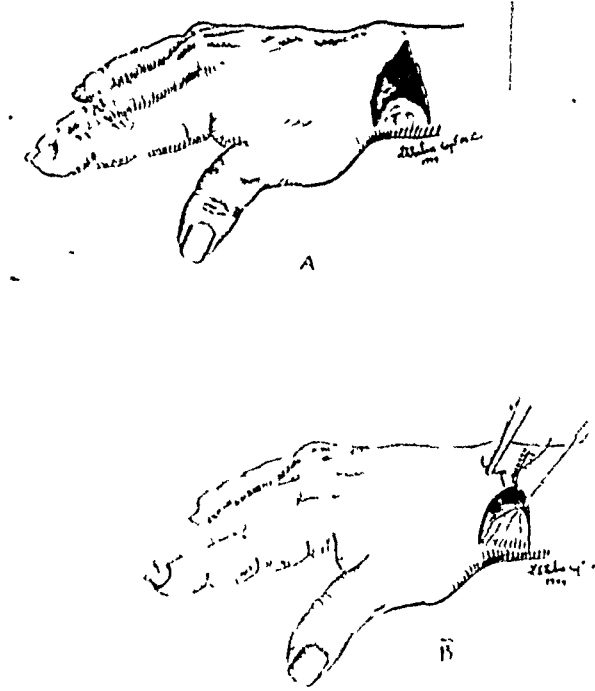
FIG. 9A.

FIG. 9B.

FIG. 9. A and B, combined rotation and advancement in closure for triangular defect. Location and direction: Radial and dorsal aspects of wrist, transverse direction Size: 4 cm. by 5 cm. Wound edges trimmed and extensive undermining done. One radial flap extended and advanced to complete a Y closure.

to obtain reflex vasodilatation in the extremities without increasing the meta-

nerve lesions must be a deciding factor in choosing the best method of wound
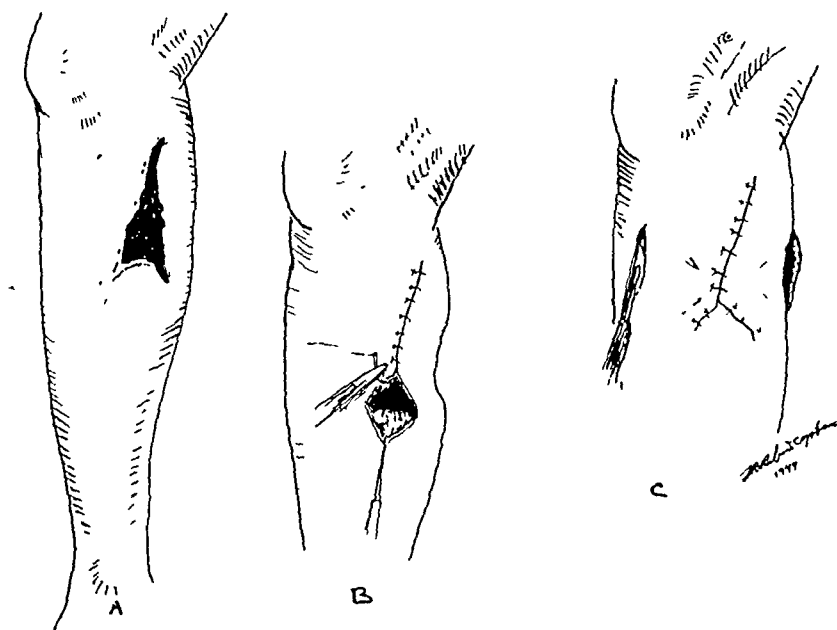
FIG. 10A to C.

FIG. 10D.

FIG. 10. A to D, combined rotation and advancement Y closure with relaxing incisions for a triangular defect. Location and direction: Posterolateral aspect of leg, middle third, longitudinal direction. Size: 11 cm. by 5 cm Deep tissue loss of peroneal muscle. Wound closure left considerable tension. Two incisions were made through the skin through the areas of greatest tension. This left two gaping wounds but relieved the tension. Two weeks later the incisions were secondarily closed.

bolic needs of the tissues compromised by the surgery and wound.

Nerve Complications. At the present time the concept of early surgical repair of

closure. Since the wound must be clo: soon as possible, the neurosurgeon s be consulted about the procedure will make his eventual repair easi

extensive flap repairs are to be done in the presence of a nerve lesion, it might be a better plan to use a split skin cover immediately. This would avoid any scarring

not helped us much except in certain categories, such as the Streptococcus and gas bacillus strains, in association with which tissue necrosis surely followed.
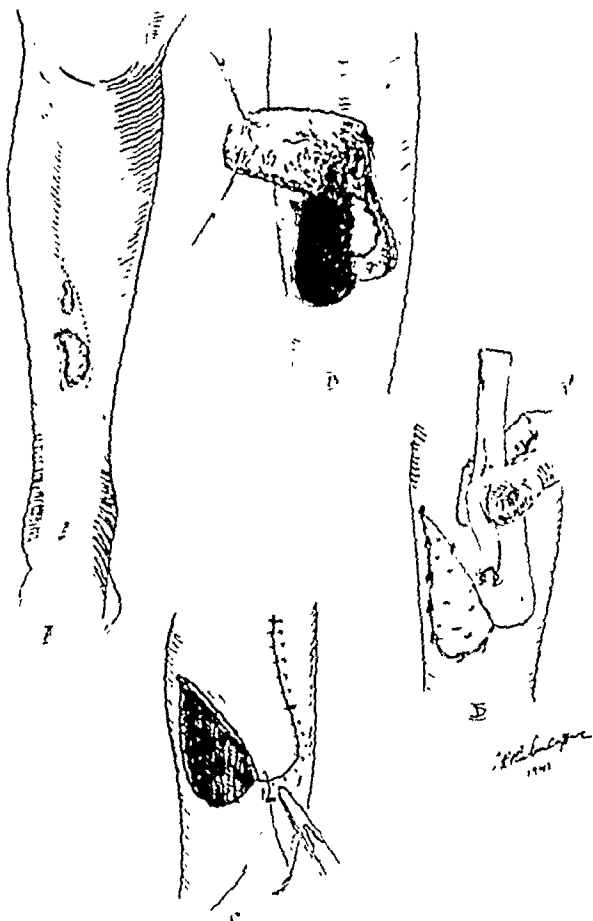
FIG. 11A to D.

FIG. 11E.

FIG. 11. A to E, transposition closure for irregular ovoid wound with exposed tibia. Location and direction: Middle third of leg, over tibia, longitudinal direction. Size: 7.5 cm. by 5 cm. The exposed tibia prevented wound healing for four months. A flap was raised and delayed. It was followed by a Streptococcus hemolyticus cellulitis several days later. Wet dressings were applied and ten days later the flap was raised and delayed once more. The final transposition was made after another six days and the wound was covered. The defect left by the transposed flap was covered, after two weeks by a split skin graft, using the gum acacia technic.[5]

which might make the neurosurgical task more difficult. If necessary, the split skin can be excised after the nerve repair and the appropriate skin flap applied.

Infection. The presence of gross infection will break down the best repair. All of our wounds were contaminated, many definitely infected. The use of penicillin has diminished the virulence of the bacteria present and prevented the spread of infection through tissues laid open by surgery. The identification of various organisms has

In other wounds, we are certain some of the necrosis found at the wound edges had its cause in tissue breakdown by bacteria even though they were of the secondary invader type, such as Staphylococcus albus, pyocyaneus and the cornybacterium groups.

Tension. In the attempt to close a wound, there is a tendency to use towel clips, forcing the wound edges together and then suturing. Necrosis naturally follows. To avoid the tension we undermine freely
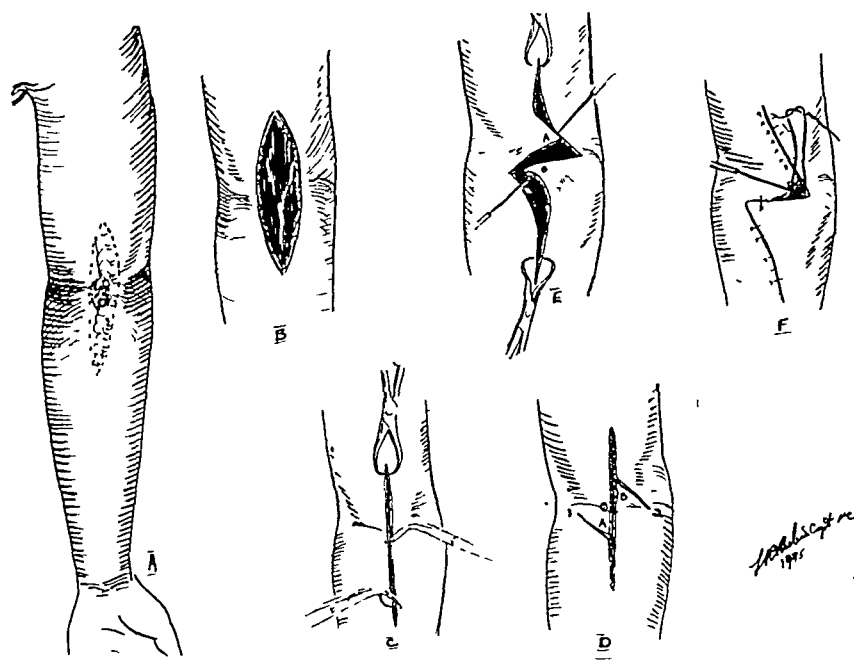
FIG. 12A to F.

FIG. 12. A to G, z plastic transposition for ulcerated con
tracted wound. Location and direction: Antecubital space,
vertical direction. Size. 10 cm. by 2½ cm. Contracted
ulcerated wound of four month's duration. Elbow exten-
sion limited to 130 degrees. z plastic procedure was chosen
because of position and comparatively narrow wound. B,
shows gaping after excision of cicatrical wound. C, illus-
trates formation of a vertical straight wound after exten-
sive undermining has permitted an easy closure without
tension. It was necessary to undermine about three-
quarters around the elbow. Where the horizontal joint
crease crosses the vertical wound, the point o is placed. D,
shows the two parallel incisions 1A and 2B, through all
layers of skin and fat, each 60 degrees with the vertical.
The ends of the lines do not extend beyond o. The flaps
are then transposed as shown in E. An important part of
the technic is to avoid tip necrosis by not placing through-
and-through sutures at the tips of the flaps. F and G,
show the final results.

and use the different skin incisions shown in the diagrams. This allows us to make the best use of the skin elasticity. To be sure

Some had had as many as four unsuccessful attempts. Many were infected; all were contaminated.
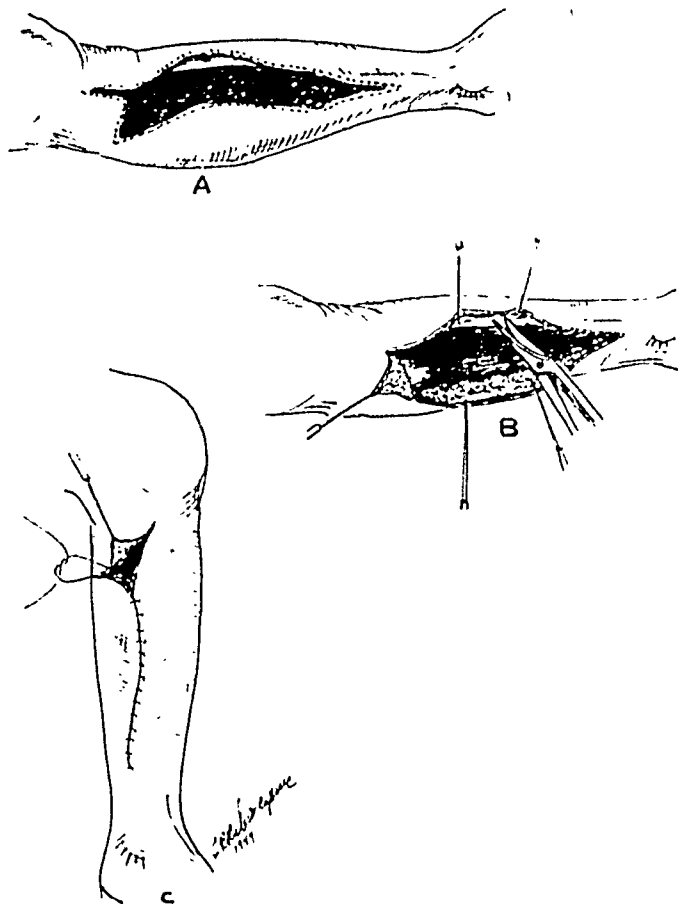
FIG. 13A to C.

FIG. 13D.

FIG. 13. A to D, advancement y closure for extensive irregular wound. Location and direction: Lateral aspect of leg, vertical direction. Size: 18 cm. by 5 cm. Extensive loss of peroneal muscles and associated nerve injury. Tibia incompletely fractured and exposed. A previous simple partial closure resulted in wound breakdown. Marked undermining and closure of wound in a modified y resulted in an early healed lesion.

of no edge-to-edge strain, as one advances the skin, rows of subcutaneous sutures are laid down, fastening the flap to the underlying tissues and so relieving the tension on the wound edge. (Fig. 4.)

SUMMARY OF RESULTS

Fifty selected war wounds of the extremities were closed by the various contiguous skin flap technics. Most of the wounds were old wounds, which had had secondary closures elsewhere with failures.

The wounds of the thigh and buttock presented no problems in closure. Except for superficial suture necrosis and secondary infection the wounds healed readily. The overall picture of the wounds of the upper two-thirds of the leg was good. However, the results of the three cases in the lower one-third of the leg were poor. In two of these cases, there were exposed, infected tendons. Attempted closure by rotation or transposition was followed by necrosis. The skin of the lower one-third

of the leg contains little fatty subcutaneous tissue with resulting impairment of blood supply and poor skin elasticity when the

increases at the expense of the width, any considerable loss of tissue in the width would prevent the use of the technic. None
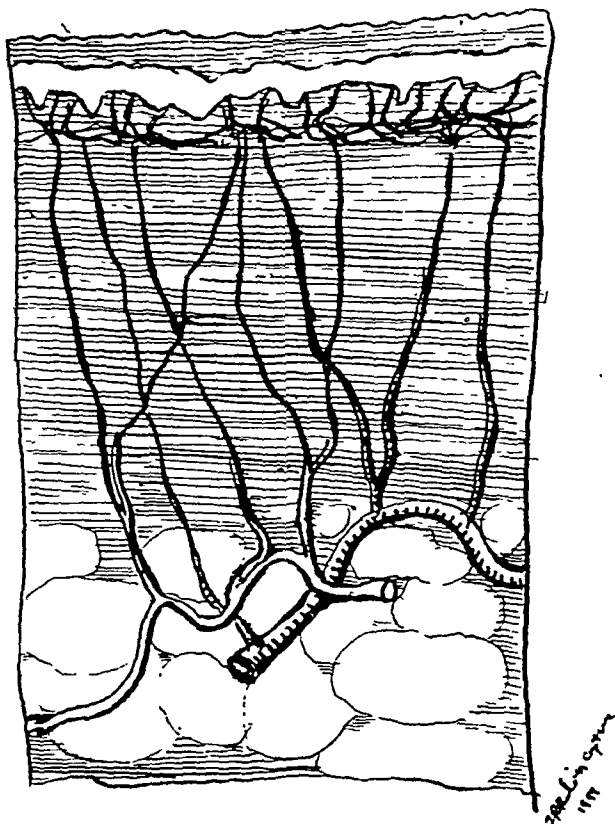
FIG. 14. Illustration of the course of blood vessels in the fat just under the skin. From these larger vessels, capillaries rise in a vertical direction to anastomose just under the stratum germinativum.

flaps are raised. Transposition of tissue in this region is also inadvisable because of the superficial tendons found laterally, medially and posteriorly and a procedure at this level exposes them.

The wounds of the arm and forearm were closed without difficulty. Our cases of wounds of the antecubital, groin and popliteal spaces, where "z" plastics were performed, should be critically examined. The patients operated upon presented either open wounds or contracted, broken down, contaminated areas. The "z" plastic was employed to change a straight line to a broken one, thus avoiding a direct line of contracture, as well as to remove the contracted deformity by obtaining an overall increase in length. Since the length

of our cases were more than 5 cm. wide, either in an open wound or after excision of the cicatrix. To effect closure, it was necessary to do radical undermining of the flaps. At times, about three-quarters of the skin encircling the arm would be raised. This would impair the flap circulation with occasional necrosis of the tips of the flaps despite very careful handling of the skin.

Seven antecubital space wounds closed by the "z" plastic healed well. Those of the popliteal space presented a greater problem. Since the circulation of the lower extremity was not as good as that of the upper, the "z" plastic technic called for two stages. Attempted one-stage closures resulted in discoloration and marked cyanosis of the transposed flaps. The delayed

procedures increased blood circulation. In the five cases of popliteal "z" plastics, it was noted that a one-stage procedure broke down completely, and a split-skin graft had to be applied later. Another one-stage procedure done under a lumbar sympathetic paravertebral block showed distal flap necrosis which was not extensive. This healed under wet dressings. Three cases were of two-stage procedures, of which two had in addition paravertebral blocks. They showed very little flap necrosis.

Two "z" plastics for groin wounds were failures. One broke down upon walking several days after operation. Both grew the usual non-pathogenic cultures. Apparently the resistance of the very thin skin in this area is impaired by extensive undermining. Both of these wounds required split skin grafts for the final closure.

The final results of "z" plastics are good if the cases are properly selected. For any wound of the popliteal or antecubital space which measures over 5 cm. in width, a split skin graft is certainly the procedure of choice. The successful "z" plastic will give a non-adhering, full-thickness and fatty skin cover. Great care, however, is required to obtain the exact size for both skin flaps. Extensive undermining is the keynote. Hooks should be used to avoid trauma to the tissue and fine suture material should be employed.

CONCLUSIONS

1. The contiguous skin flap is a full-thickness skin cover for wounds of the extremities where too much skin has not been lost and where bone, tendon or fascia-less muscles have been exposed.

2. The flaps raised must include all layers of fat down to fascia.

3. Free, extensive undermining is imperative.

4. Stage operations are necessary where the flaps are large or circulation impairment is feared.

5. Sympathetic blocks, nerve block anesthesia and the proper use of heat for the increase of circulation are valuable during the critical postoperative period.

6. The surgical technics are not new but must be exactly understood and followed.

7. The contiguous skin flap is designed primarily for utility and no attempt has been made to obtain a cosmetic result.

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STUDIES ON NEUROMUSCULAR DYSFUNCTION*

NEOSTIGMINE THERAPY OF CHRONIC DISABILITY FOLLOWING FRACTURES
REPORT OF FIFTY-ONE CASES

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IT is now generally accepted that neostigmine is the drug of choice in providing relief from fatigue and weakness in the treatment of myasthenia gravis.[1] Neostigmine is believed to act in facilitating transmission of excitation across the myoneural junction by inhibiting cholinesterase and thereby allowing accumulation of acetylcholine at nerve endings.[2]

Recently, significant improvement has been reported from the use of neostigmine in a variety of types of neuromuscular dysfunction. In subacute and chronic poliomyelitis, Kabat and Knapp[3] observed that neostigmine resulted in relaxation of muscle spasm, relief from pain, increase in strength and improvement in muscular coordination. Neostigmine has been shown to be of value in relieving neuromuscular dysfunction in chronic rheumatoid arthritis,[4,5] chronic hemiplegia,[5] chronic facial paralysis,[5] cerebral palsy,[5,6] chronic disability resulting from trauma,[5] cervical intramuscular fibrositis (stiff neck),[7] and acute and chronic backache.[8] Further studies on the clinical use of neostigmine in poliomyelitis have been published.[9-12] Electromyographic studies on patients with poliomyelitis revealed a decrease in irritability of the stretch reflex and a diminution in action potentials associated with muscle spasm following injection of neostigmine.[13] These new developments in the use of neostigmine in the treatment of neuromuscular dysfunction have been reviewed.[14]

In a preliminary report on neostigmine therapy for neuromuscular dysfunction resulting from trauma, Kabat[5] described eight cases of chronic disability following fractures. These patients suffered from persistent joint stiffness, limitation of motion, pain, muscular weakness and fatigue following fractures of various types. The disability had been present for two and one-half months to three years and had not been responding to physical therapy. Seven of these patients showed significant improvement in their disability during one to three weeks of daily injections of neostigmine. In some of these cases, dramatic relief from pain, increase in range of motion and increase in strength were observed within a few days after initiating neostigmine treatment.

These encouraging preliminary results with neostigmine in the treatment of chronic disability following fractures prompted the present study. Fifty-one patients with chronic disability following fractures of various types have been treated with neostigmine and the objective and subjective effects of the drug treatment on the disability have been carefully evaluated. The original preliminary observations have been confirmed; in this series of cases, 76 per cent have shown significant improvement from neostigmine therapy.

MATERIAL AND METHODS

The patients selected for study had been suffering from chronic disability following fractures for a considerable period of time, had not shown spontaneous exacerbations or remissions and were showing little or no progress from routine physical therapy. The disability could in every case be demon-

strated objectively and muscle spasm or contracture, paresis and pain appeared to play a major rôle. Patients showing evident ankylosis, bony block, non-union, denervation, active inflammation or nervous and emotional disorders were excluded.

Most of the cases were treated as out-patients, a majority having received therapy at the U. S. Public Health Service Dispensary, Washington, D. C. Other cases were treated at U. S. Marine Hospitals in Hudson Street, New York, Stapleton, Staten Island, New York, Norfolk, Virginia and Baltimore, Maryland. Previous therapy had consisted of standard methods of reduction and immobilization of the fracture followed by routine physical therapy.

All observations on these cases were made by the authors. Routinely, the patients were examined at least once a week and careful records were kept of all subjective and objective findings. All examinations on a single case were performed by the same examiner.

Range of passive motion was measured wherever possible by means of a goniometer using uniform bony points as landmarks and was recorded in angles. For the upper extremity, the goniometer was used to measure range of abduction, forward flexion and extension at the shoulder, flexion and extension at the elbow. For the lower extremity, range of passive motion was recorded by means of the goniometer for straight leg raising, hip flexion with the knee flexed, abduction at the hip, flexion and extension at the knee and dorsiflexion and plantar flexion at the ankle. Limitation of range of passive motion in other motions of the extremities were estimated by comparison with the normal extremity and recorded as per cent of limitation of motion. Limitation of flexion of the trunk was measured by having the patient attempt to touch the toes with the knees straight and measuring the distance of the fingertips from the floor. Limitation of passive finger flexion and extension was measured as the distance of the fingernail from the depth of

the palm or as the distance of the finger tip from the distal crease of the wrist.

Pain at the point of limitation of passive motion was estimated and recorded as follows: 0, no pain; 1+, slight pain; 2+, moderate pain; 3+ severe pain.

In every patient with a fracture in an extremity, passive range of every motion at every joint in that extremity was tested in the original examination. In subsequent examinations, passive motion was observed only in those motions which had shown limitation of passive range in the original examination. In patients with fracture of the spine, thorough examination of range of passive motion of the lower extremities was carried out.

Strength of voluntary motion was tested for every motion at every joint in the extremity in which a fracture had been sustained. Voluntary muscular power of all motions of the lower extremities was tested in patients with fracture of the spine. The tests of strength for each motion at a joint were carried out in a standardized manner. No attempt was made to isolate individual muscles for testing of strength; the test was for voluntary power of a muscle group in carrying out a particular motion at a joint. In almost all cases, the unfractured contralateral extremity served as a means of comparison and standard of normal strength in facilitating the estimation of strength of muscle groups.

Voluntary power was recorded by a standard numerical system of recording as follows:

0—No contraction.
1—Slight contraction but incapable of producing joint motion against gravity.
2—Voluntary motion against gravity through only part of the total passive range.
3—Voluntary motion through the full passive range against gravity but no motion against any resistance.
4—Voluntary motion through the full passive range against slight resistance.

5—Voluntary motion through the full passive range against moderate resistance.

6—Voluntary motion through the full passive range against strong resistance, but significantly weaker than the same motion of the unaffected opposite extremity.

7—Normal strength, equal to or greater than the same motion in the unaffected opposite extremity.

Most patients with weakness following fracture had voluntary muscular power ranging from 2 to 6 by this method of recording.

Pain in voluntary motion was recorded as: 0, no pain; 1+, slight pain; 2+, moderately severe pain; 3+, severe pain.

In cases in which voluntary muscular contraction was incapable of moving the joint through the full passive range against gravity, the angle of range of active motion was measured by means of a goniometer.

In addition to these tests, a number of other tests were used routinely to describe the disability: (1) Upper extremity, ability to touch the top of the head, back of the neck, opposite shoulder, opposite ear over the head, opposite flank behind, etc. (2) Lower extremity, gait, ability to walk on toes and heels, ability to stand on a chair on one leg, etc.

Each patient was questioned in detail about subjective symptoms, ability to carry out ordinary activities, fatigue, muscle cramps, etc. Definite changes in these findings during and after treatment were carefully evaluated.

During the period of observation and treatment all therapeutic measures, including physical therapy were discontinued. As a control procedure to evaluate the effects of the daily intramuscular injection, twenty of the patients were given daily injections of saline for one week before initiation of neostigmine therapy without being aware that a placebo was being administered.

Neostigmine was administered intramuscularly once daily. The dosage used was neostigmine* methylsulfate, 2 cc. of 1:2000 solution (1 mg.) together with atropine sulfate gr. $\frac{1}{150}$ (0.43 mg.); or neostigmine methylsulfate 3 cc. of 1:2000 solution (1.5 mg.) together with atropine sulfate gr. $\frac{1}{100}$ (0.65 mg.). In the out-patients, injections were administered six times per week, omitting Sunday. The atropine was used to eliminate the unpleasant parasympathetic side-effects of neostigmine. Neostigmine therapy was continued as a rule for two to four weeks. After treatment was discontinued, the patients were followed for as long as possible to determine whether the improvement in the disability was retained.

In our experience, administration of neostigmine for chronic disability following fracture is a safe procedure. Most of the out-patients continued to work throughout the period of neostigmine therapy. Thirty-three of the fifty-one patients were over forty years of age:

Age	No. of Patients
40–49	13
50–59	15
60–69	3
70–	2

Many patients had no reaction at all from the injections. The dosage of atropine had to be adjusted up or down to overcome mild reactions in individual cases. Some patients experienced fascicular twitching, a feeling of thickness of the tongue, slight dizziness and stimulation of intestinal peristalsis. Reactions were minimized by administration of the drugs soon after a meal. As a rule, side-effects were greater at first and decreased after treatment was continued for a few days. In no case were serious reactions observed and treatment did not have to be discontinued in any of these patients because of toxic effects. Since susceptibility to neostigmine and to atropine varies considerably in different individuals, the best procedure is to start

* The neostigmine methylsulfate was furnished through the courtesy of the Hoffman-La Roche Co., Nutley, N. J.

with a small dose of the drugs and build up the dose in the course of a few days to the tolerance of the individual.

RESULTS*

Case Data. The essential data in the fifty-one cases of chronic disability following fractures treated with neostigmine are recorded in Tables I, II and III. Every patient with chronic disability following a fracture who has received a course of neostigmine injections has been included in this series of cases.

Of the total of fifty-one patients, twenty-three had fractures of the upper extremity, seventeen had fractures of the lower extremity, seven had fractures of vertebrae and four had sustained multiple fractures. The ages of these patients varied from seventeen to seventy-two years, with an average age of forty-four years. Most of the patients were males; only seven in the series were females. The duration of the disability ranged from two months to twenty-seven years. Excluding the disabilities which had been present longer than five years, the average duration of the disability was 11.2 months.

Of twenty patients who were given daily injections of saline for one week as a placebo preceding the administration of neostigmine, only two showed any improvement from the placebo, the others showing absolutely no change in the disability from these control injections. The two patients who improved on saline showed slight but not significant improvement.

Neostigmine was usually administered for two to three weeks. This treatment resulted in significant improvement in thirty-nine of the fifty-one cases studied; thus 76 per cent of these patients with chronic disability following fractures obtained significant benefit from neostigmine.

Since the cases were all chronic and had not been improving appreciably on physical therapy, these results are definitely significant. Of the remaining twelve cases, four showed definite but slight improvement, which, however, was not significant in relieving the disability, while the other eight cases showed no improvement at all from neostigmine therapy. In patients with fracture of the upper extremity, sixteen out of twenty-three or 70 per cent showed significant improvement from neostigmine therapy. (Table I.) Of seventeen patients with fracture of the lower extremity, fourteen or 82 per cent showed significant improvement from neostigmine. (Table II.) Of seven patients with fracture of vertebrae, six or 85 per cent showed significant improvement and of four patients with multiple fractures, three or 75 per cent showed significant improvement from neostigmine. (Table III.) It is thus evident that a similar proportion of patients suffering from chronic neuromuscular dysfunction following fractures are significantly improved by neostigmine regardless of the location of the fracture.

It has been possible to follow twenty-seven of the thirty-nine patients who showed significant improvement from neostigmine therapy for one to eight months after treatment was discontinued. In all except one of these cases, the improvement was retained after cessation of drug administration.

Representative case reports of patients showing marked improvement[+++] from neostigmine therapy are presented below. These patients were treated as out-patients and continued to work while under treatment. All other types of treatment for the disability were discontinued during the period that these patients were under observation.

CASE REPORTS

CASE 8. This sixty-seven year old woman sustained a comminuted fracture of the distal end of the left radius and ulna in January, 1944. (Table I.) Nine and one-half months later,

TABLE I
NEOSTIGMINE THERAPY OF CHRONIC DISABILITY FOLLOWING FRACTURES
FRACTURES OF THE UPPER EXTREMITY

+ + + Marked improvement } Significant improvement
+ + Moderate improvement }
+ Slight improvement } Not significant
o No improvement }

Case No	Age	Sex	Diagnosis	Duration of Disability (months)	Improvement on Saline, 1 Week	Period of Neostigmine (weeks)	Improvement on Neostigmine	Passive Range	Voluntary Power	Pain	Fatigue	Follow-up (months)	Improvement Retained
1	47	F	Fracture left radius and ulna, distal third	5		2	+++	++	+++		+++	8	Yes
2	27	M	Comminuted fracture surgical neck right humerus Fracture acromion process right scapula Dislocation right shoulder	6	o	2	+++	+++	++	+++	++	¼	Yes
3	32	M	Fracture internal condyle left humerus Laceration flexor tendons left forearm	2	o	2	++	++	++	++	++	4	Yes
4	56	M	Fracture head of right radius	–	o	2	o	o	o	o	o		
5	51	M	Compound fracture right radius and ulna distal end Compound dislocation right wrist Laceration flexor tendons right wrist Osteomyelitis for 2 years	60		4	+++	+++	+++	+++	+++	5	Yes
6	56	F	Fracture right radius and ulna, proximal third	2	o	2	++	++	++	+++	+++	6	Yes
7	54	M	Fracture of right radius, distal third Fracture right ulnar styloid Dislocation right distal radio-ulnar articulation	3		2	+	o	o	++	o	1	Yes
8	67	F	Comminuted fracture left radius and ulna, distal end	9½	o	3	+++	+++	+++	+++	+++	6	Yes
9	40	M	Fracture right radius and ulna, distal third	324		2	o	o	o	o	o		
10	22	M	Fracture left humerus, distal end	17	o	2	o	o	o	o	o		
11	41	M	Fracture right 4th metacarpal and distal phalanx of index finger Dislocation right 5th metacarpal Laceration of extensor tendons of fingers 3, 4 and 5 and flexor tendon finger 5 in right hand	17		3	+++	+++	+++	+++	+++	3	Yes
12	34	M	Fracture head of right radius	11	o	2	o	o	o	o	o		
13	36	M	Fracture compound comminuted right humerus, middle third Fracture right radius and ulna, middle third (External skeletal fixation still applied to right forearm)	5		3	++	++	++	+++	+++	2	Yes
14	31	M	Chip fracture greater tuberosity right humerus Dislocation right shoulder, laceration capsular ligaments	2½	o	2	+++	+++	++	+++	++		
15	53	M	Fracture right clavicle, distal end	2	o	2	+	++	o	o	o		
16	41	M	Fracture acromion process left scapula	5		2	+++		+++	++	+++	1	Yes
17	57	M	Fracture greater tuberosity left humerus	2½	o	2	o	o	o	o	o		
18	51	M	Fracture right radius, proximal third Comminuted fracture right ulna, distal third Dislocation right radius and ulna, proximal end Osteomyelitis (Right forearm and wrist in cast)	10	+	2	++	+	++	++	++	6	Yes
19	33	F	Fracture olecranon process, left ulna	2½		3	+++	+++	+++	+++	+++		
20	65	M	Comminuted fracture, head of right humerus	6		4	+++	++	+++	+++	+++	5	Yes
21	55	F	Fracture left radius and ulna, distal third	30	o	3	+++	+++	+	+++	+	5	Yes
22	62	M	Comminuted fracture proximal phalanx left index finger	3	·	2	++	+	++	++	++		
23	47	M	Chip fracture in left radio-humeral joint	11		2	+++	++	+++	+++	+++	1	Yes

despite continuous treatment, the left arm was seriously disabled and no progress had been observed for several months. There was

serious deformity. There was great weakness and fatigue in voluntary motion in pronation, supination and in wrist motions, and she suf-

TABLE II

NEOSTIGMINE THERAPY OF CHRONIC DISABILITY FOLLOWING FRACTURES
FRACTURES OF THE LOWER EXTREMITY

+++ Marked improvement }
++ Moderate improvement } Significant improvement
+ Slight improvement }
o No improvement } Not significant

Case No.	Age	Sex	Diagnosis	Duration of Disability (months)	Improvement on Saline 1 Week	Period of Neostigmine (weeks)	Improvement on Neostigmine	Improvement in:				Follow-up (months)	Improvement Retained
								Passive Range	Voluntary Power	Pain	Fatigue		
24	42	M	Fracture head of left femur.	28	..	2	+++	+	......	+++			
25	56	M	Fracture neck of left femur.	18	o	2	++	++	++	+++	++	4	Yes
26	46	M	Fracture right and left tibia and fibula, middle third.	10	o	2	o	o	o	o	o		
27	47	M	Comminuted fracture external tuberosity left tibia; comminuted fracture neck left tibia.	14	..	3	+++	+++	+++	+++	+++	7	Yes
28	29	M	Comminuted fracture, lateral aspect head of left tibia.	13	..	2	++	++	......	......	++	6	Yes
29	33	M	Fracture left femur, middle third.	20	..	4	+++	++	+++	++	+++	3	Yes
30	40	M	Fracture neck of right femur. Traumatic arthritis, right hip	16	..	2	++	+	++	++	+		
31	22	M	Compound fracture left tibia and fibula, lower third. Peroneal paralysis. Osteomyelitis.	9	..	2	+++	+++		+	+++	+++	
32	55	M	Comminuted fracture left os calcis with exostosis.	8	o	2	o	o	o	o	o		
33	17	M	Fracture right femur, middle third. Fracture left patella. Fracture right femur, middle third (second time).	42 / 36	.	2	++	+	++	++	++	2	Yes
34	54	M	Compound fracture left tibia and fibula, distal end. Dislocation left ankle.	4	..	1	+++	+++	++	+++	++		
35	20	M	Fracture right femur, lower third. Amputation below knee.	4	..	1½	+	++	o				
36	50	M	Fracture right tibia and fibula, distal end.	6	..	3	++	o	++	++	++	2	Yes
37	37	M	Fracture left tibia and fibula, distal end. Paralysis left lower extremity from poliomyelitis.	4 / 408	.	3	+±	+	++	+++	+++	1	Yes
38	34	F	Fracture right tibia and fibula, distal end.	3	..	2	+++	+++	+++	+++	+++	2	Yes
39	59	M	Fracture right femur, lower third. Malunion. Fracture left tibia and fibula, upper third.	24 / 288	..	3	++	++	+++	+++	++	4	Yes
40	41	M	Fracture left tibia, middle third. (External skeletal fixation still applied.)	4	..	2	+++	+++	......	+++			

marked limitation of passive motion at the left shoulder, wrist and fingers. (Table IV.) The fingers could be flexed passively to one inch from the palm and there was marked limitation of extension of the fingers, resulting in a

fered from pain in ordinary use of the left upper extremity. (Table IV.) The left hand was cold and white as a result of poor circulation.

After one week of saline as a placebo, there was no significant change in the disability.

(Table IV.) After one week of neostigmine therapy, there was a definite and significant increase in range of motion and of voluntary muscular power. (Table IV.) The fingers could

showed marked improvement. (Table IV.) There was marked improvement in flexion and extension of the fingers and in circulation in the left hand. Pain and excessive fatigue in

TABLE III

NEOSTIGMINE THERAPY OF CHRONIC DISABILITY FOLLOWING FRACTURES
FRACTURES OF VERTEBRAE AND MULTIPLE FRACTURES

+++ Marked improvement ⎫ Significant improvement
 ++ Moderate improvement ⎭

  + Slight improvement ⎫ Not significant
  o No improvement ⎭

Case No.	Age	Sex	Diagnosis	Duration of Disability (months)	Improvement Saline 1 Week	Period of Neostigmine (weeks)	Improvement on Neostigmine	Passive Range	Voluntary Power	Pain	Fatigue	Follow up (months)	Improvement Retained
41	30	M	Compression fracture, 2nd lumbar vertebra.	–	..	1½	+++	++	......	+++	.....	¼	Yes
42	52	M	Compression fracture 12th thoracic, 1st lumbar and 5th lumbar vertebrae. Fracture first right metacarpal. Fracture external condyle right tibia.	–	..	3	++	+	++	++	......	1	Yes
43	49	F	Fracture of coccyx.	5	..	2	+++	......	.. ...	+++	. . ..	2	Yes
44	45	M	Compression fracture 1st lumbar vertebra. Bilateral fractures of ischium and pubis. Fracture left wing of sacrum. Non-union of pelvic fractures. Distortion of pelvis.	11	+	2	o	o	o	o	o		
45	51	M	Compression fracture 1st lumbar vertebra.	17		5	+++	++	+++	+++	++	3	Yes
46	48	M	Compression fracture 3rd lumbar vertebra. Fracture left transverse processes of lumbar 1, 2, 3 and 4 vertebrae. Fracture right radius and ulna, proximal end. Dislocation right elbow.	12	o	7	++	++	+++	++	++	2	No
47	34	M	Fracture right transverse processes 3rd and 4th lumbar vertebrae.	3	..	2	+++	+++	....	+++	......	¼	Yes
48	70	M	Fractures of pelvis; right radius and ulna; right tibia and fibula.	4	o	2	++	++	++	+	++		
49	31	M	Compound comminuted fracture left femur, middle third. Fracture left clavicle and acromion process left scapula.	8	o	3	++	++	+++	++	++	5	Yes
50	72	M	Fracture left femur, tibia and fibula, radius and ulna.	10	o	2	+	+	+	o	o		
51	39	M	Fracture right tibia, upper third. Fracture head of right fibula. Fracture right patella. Fracture left patella. Fracture right radius and ulna, distal third.	30	..	2	+++	o	+++	+++	+++	2	Yes

be flexed to ¼ inch from the palm, the little finger flexed to touch the palm and range of extension of the fingers was increased significantly. Pain and fatigue were diminished. After three weeks of neostigmine injections, strength was normal in all motions of the left upper extremity and range of passive motion

the left upper extremity had entirely disappeared. This patient has been followed for six months after neostigmine was discontinued and the improvement was completely retained. At the last examination, there had been slight further improvement in range of motion at the wrist.

TABLE IV

EFFECTS OF NEOSTIGMINE ON RANGE OF PASSIVE MOTION AND VOLUNTARY MUSCULAR POWER.
CASE 8—COMMINUTED FRACTURE, LEFT RADIUS AND ULNA, DISTAL END. DURATION $9\frac{1}{2}$ MONTHS.
FEMALE, AGE 67

(Methods of measurement and recording described in text under "Material and Methods")

Left Upper Extremity	Passive Motion					Voluntary Muscular Power				
	Before Treatment	Saline, 1 Week	Neostigmine			Before Treatment	Saline, 1 Week	Neostigmine		
			1 Week	2 Weeks	3 Weeks			1 Week	2 Weeks	3 Weeks
Shoulder—abduction	95°	90°	105°	120°	135°					
forward flexion	110°	110°	130°	140°	150°					
external rotation	80% L*	80% L	20% L	10% L	10% L					
Elbow—supination	10% L	10% L	0†	0	0	5	5	6	6	7
pronation						5	5	6	7	7
Wrist—flexion	50% L	50% L	50% L	40% L	20% L	6	6	7	7	7
extension	100% L	100% L	80% L	70% L	70% L	4	4	6	6	7
ulnar deviation	90% L	90% L	90% L	50% L	40% L	4	4	5	7	7
radial deviation	90% L	90% L	90% L	90% L	90% L	4	4	7	7	7

* 80% Limitation or 20% of normal range of motion.
† No limitation or normal range of motion.

TABLE V

EFFECTS OF NEOSTIGMINE ON RANGE OF PASSIVE MOTION AND VOLUNTARY MUSCULAR POWER.
CASE 27—COMMINUTED FRACTURES EXTERNAL TUBEROSITY LEFT TIBIA AND NECK OF LEFT FIBULA.
DURATION 14 MONTHS. MALE AGE 47

(Methods of measurement and recording described in text under "Material and Methods")

Left Lower Extremity	Passive Motion					Voluntary Muscular Power				
		Neostigmine					Neostigmine			
	Before Treatment	1 Day	1 Week	2 Weeks	3 Weeks	Before Treatment	1 Day	1 Week	2 Weeks	3 Weeks
Hip—flexion	....					5	6	6	7	7
abduction	....					4	6	7	7	7
adduction	....					6	7	7	7	7
Knee—flexion	130°	110°	105°	110°	110°	6	7	7	7	7
Ankle—dorsiflexion	110°	106°	102°	100°	100°	5	7	7	7	7
plantar flexion	148°	148°	145°	150°	162°	7	7	7	7	7
inversion	90% L*	50% L	25% L	25% L	10% L	5	7	7	7	7
eversion	90% L	50% L	50% L	50% L	50% L	7	7	7	7	7
Toes—flexion	50% L	25% L	10% L	10% L	10% L	4	5	5	7	7
extension	50% L	25% L	10% L	10% L	10% L	7	7	7	7	7

* 90% Limitation or 10% of normal range of motion.

CASE 27. This forty-seven year old man sustained comminuted fractures of the external tuberosity of the left tibia and of the neck of the left fibula into the knee joint in September, 1943. (Table II.) Fourteen months after the injury, despite continuous physical therapy, he complained of serious disability of the left lower extremity and had shown no improvement for months. He suffered from pain in the left knee and ankle and frequent cramps in the thigh muscles. The pain in the ankle was severe enough to awaken him from sleep every night. There was marked limitation of passive motion at the left knee, and ankle (Table V), which seriously interfered with lacing his shoes, driving a car, walking upstairs, etc. He walked with a moderately severe limp. The left lower extremity was weak (Table V) and fatigued very readily.

Following the first injection of neostigmine, the patient noted that he was not awakened by pain in the ankle. There was striking relief from pain and fatigue, which was associated with a definite increase in range of motion and strength. (Table V.) After three weeks of neostigmine therapy, all pain, muscle cramps and excessive fatigue in the left lower extremity had completely disappeared. Voluntary muscular power in all motions of the left lower extremity was restored to normal and there was significant improvement in range of passive motion. (Table V.) The patient walked without a limp and found it easy to lace his shoes, drive a car and walk upstairs. He has been followed for seven months since neostigmine therapy was discontinued and has retained the improvement.

CASE 45. This fifty-one year old man sustained a compression fracture of the first lumbar vertebra with marked wedging in May, 1943. (Table III.) He continued to complain of severe disability in spite of treatment and had failed to show significant improvement for many months. Seventeen months after the injury, he complained of severe pain in the back and frequent incapacitating shooting pains from the lumbar region down the lateral aspect of the right leg into the toes. The pain routinely interfered with sleep and caused him to be out of work approximately two days in every six. He complained of marked fatigability, especially of the right lower extremity. There was moderate limitation of motion of the lumbar spine in flexion and lateral motion; in bending forward with the knees straight, the fingertips reached to 14 inches from the floor. There was no limitation of motion in the lower extremities but passive straight leg raising resulted in severe pain in the lumbar region. Because of limitation of motion and pain, he was unable to put on and remove his socks and shoes himself. The stiffness in the back was greater on arising and caused great difficulty in getting out of bed. He had difficulty in squatting and in putting his foot on a chair. The patient was unable to stand on a chair on his right leg and had great difficulty in standing on a chair on the left leg. He was unable to walk on the toes of the right foot. Voluntary muscular power was below normal in motions of both lower extremities. (Table VI.)

A roentgenogram taken seventeen months after the injury revealed deformity of the body of the first lumbar vertebra and union of the bodies of the twelfth thoracic and first lumbar vertebrae by callus. The normal curve of the lumbar spine was absent.

Daily injection of neostigmine methylsulfate 2 cc. of 1:2000 solution with atropine sulfate gr. $\frac{1}{150}$ were administered intramuscularly. After five injections, the patient reported a striking decrease in frequency and severity of the shooting pains and was no longer awakened by pain. There was a definite increase in range of flexion and lateral deviation of the lumbar spine; he was able to bend forward to reach the fingertips to 10 inches from the floor. During the second week of treatment, the shooting pains entirely disappeared and have never recurred.

After five weeks of neostigmine therapy, he had no difficulty in sleeping and had been free from shooting pains. There was moderate improvement in the low back pain and the excessive fatigue. He was now working steadily and rarely lost a day from work because of his disability. There was significant improvement in range of motion of the lumbar spine and passive straight leg raising no longer caused pain in the back. He was putting on and removing his own socks and shoes without difficulty. The stiffness in the back on arising and the difficulty in getting out of bed were no longer evident. He was able to stand on a chair on either leg with ease, had no difficulty in walking on the toes and showed striking improvement in squatting. Voluntary power

had become normal in all motions of the lower extremities. (Table VI.)

The patient was followed for three months after neostigmine therapy was discontinued and fully retained the improvement. He had been entirely free from shooting pains but still had some pain in the lumbar region, worse on some days (particularly rainy days)

at cholinergic nerve endings and at synapses.[2] Evidence has been presented by Slaughter,[15] that neostigmine can potentiate the analgesic effect of morphine, but this potentiation has been questioned.[16] Neostigmine has not been considered an analgesic or a sedative.[2] Yet one of the

TABLE VI

EFFECTS OF NEOSTIGMINE ON VOLUNTARY MUSCULAR POWER CASE 45—COMPRESSION FRACTURE FIRST LUMBAR VERTEBRA DURATION 17 MONTHS. MALE AGE 51

(Methods of measurement and recording described in text under "Material and Methods")

Right Lower Extremity	Before Treatment	Voluntary Muscular Power					No Therapy
		Neostigmine					
		1 Week	2 Weeks	3 Weeks	4 Weeks	5 Weeks	3 Months
Hip—flexion	5	5	6	7	7	7	7
extension	5	5	6	7	7	7	7
abduction	5	5	6	7	7	7	7
adduction	5	5	6	7	7	7	7
external rotation	5	-	-	7	7	7	7
internal rotation	5	5	7	7	7	7	7
Knee flexion	5	5	7	7	7	7	7
extension	5	5	6	7	7	7	7
Left Lower Extremity							
Knee—flexion	5	..	7	7	7	7	7
extension	6	..	7	7	7	7	7

than others; the back pain was less frequent and less severe than before neostigmine therapy. Three months after treatment was stopped, he was given a second course of daily injections of neostigmine methylsulfate 3 cc. of 1:2000 solution and atropine sulfate gr. $\frac{1}{100}$, which caused only insignificant side-effects. This therapy resulted in a further significant decrease in frequency and severity of pain in the lumbar region and improvement in range of motion. He was now able to bend forward to reach the finger tips to eight inches from the floor without pain in the back and range and ease of hip flexion with the knee flexed was increased significantly.

Relief of Pain. Neostigmine is known to act by inhibition of cholinesterase, thereby allowing accumulation of acetylcholine

striking features of neostigmine therapy in patients with chronic disability following fractures has been the rapid relief of pain and the persistence of this pain relief after treatment was discontinued.

A number of types of deep pain have been relieved by neostigmine therapy in this series of patients with chronic disability following fractures:

1. *Pain referred to muscles:*

(a) Muscular pain relieved by neostigmine, associated with increase in range of joint motion.

CASE 19. Pain in muscles of the forearm and arm relieved by neostigmine, along with an increase in range of elbow motion of 30

degrees and restoration of full range of motion at the shoulder.

CASE. 31. Pain in calf muscles on weight bearing relieved by neostigmine, associated with increase in range of ankle motion of 25 degrees.

(b) Muscular pain relieved by neostigmine without associated increase in range of joint motion.

CASE 41. Severe pain in the muscles in the lumbar region disappeared during neostigmine therapy but there was no change in the rigid lordosis of the lumbar spine. (A similar observation has been made in cases of chronic Marie-Strumpell's arthritis with bony ankylosis).

(c) Pain associated with muscle cramps. Painful muscle cramps disappeared during neostigmine therapy and did not recur afterwards in cases 27, 37 and 39.

CASE 37. This patient had paralysis of the left lower extremity from poliomyelitis since infancy, with severe atrophy of the calf and thigh muscles. An arthrodesis of the left ankle had been performed many years before. In January, 1945, he fractured the distal end of the left tibia and fibula. Four months later, he complained of severe pain on weight bearing in the region of the left lateral malleolus and frequent painful cramps in the atrophied left posterior calf muscles. On neostigmine therapy, the muscle cramps disappeared and the pain in the region of the ankylosed ankle joint was markedly improved.

(d) Muscular pain on active motion against resistance, or associated with fatigue, without limitation of joint motion, muscle spasm or muscle cramps. This type of pain was relieved by neostigmine in cases 3, 16, 23, 24.

CASE 23. Local tenderness of left radio-humeral joint was not affected by neostigmine therapy, whereas the muscular pain on active motion against resistance and the muscular aching associated with fatigue completely disappeared.

(e) Tender painful nodule in muscle disappeared during neostigmine therapy.

CASE 21. A firm tender painful nodule about one inch in diameter protruded from the muscles on the ulnar side of the left forearm and had been present since the fracture two and one-half years before. During the course of neostigmine therapy, the pain, tenderness and the nodule itself disappeared and have not recurred. (The same phenomenon

has been observed in a case of injury of the shoulder without fracture).

2. *Pain referred to joints:*

(a) Joint pain relieved by neostigmine, associated with increase in range of motion at the joint.

Examples include:

CASE 5. Joints of fingers, right hand.

CASE 6. Joints of fingers, right hand.

CASE 11. Joints of fingers, right hand.

CASE 22. Proximal interphalangeal joint, left index finger.

CASE 27. Pain in right knee joint and right ankle joint disappeared during neostigmine therapy, associated with increase in range of knee flexion of 20 degrees and marked increase in range of motion at the ankle. (Table V.)

CASE 29. Twenty months after fracture of the middle third of the left femur, this patient had considerable pain and slight limitation of motion in the left big toe. He was unable to wear his old shoes and continued to have pain in the big toe with several different types of shoes. Passive flexion or extension of the big toe resulted in severe pain. After two weeks of neostigmine therapy, the pain and limitation of motion in the big toe had disappeared and he was wearing his old shoes without discomfort. He has been followed for three months since therapy was discontinued and there has been no recurrence.

CASE 34. Left ankle joint.

CASE 38. This woman fractured the distal end of the right tibia and fibula three months previously. There was an equinus deformity of the right foot, associated with pain referred to the ankle joint. Passive dorsiflexion was limited at 145 degrees. After one week of neostigmine therapy, the ankle pain as well as the equinus deformity had disappeared; passive dorsiflexion measured 95 degrees.

CASE 39. Right knee joint.

CASE 40. Left knee joint.

CASE 46. Right elbow joint.

CASE 51. Right knee joint.

3. *Miscellaneous types of pain:*

(a) Pain in the region of bony ankylosis of a joint:

CASE 5. Severe injury of the right wrist five years previously was complicated by chronic osteomyelitis, which resulted in bony

ankylosis of the right wrist joint. Flexion of the fingers or fatigue of the hand resulted in pain "like a tight band encircling the wrist," in a region of dense scar tissue. This pain disappeared during neostigmine therapy, associated with increased range and ease of motion and increased voluntary power in the fingers.

CASE 37. (See 1 (c)). Pain referred to the region of the lateral malleolus of the ankylosed left ankle joint was relieved by neostigmine therapy.

(b) Nerve pain. The severe shooting pains down the lateral aspect of the right lower extremity into the toes in Case 45 disappeared early in the course of neostigmine therapy. (See complete case report.)

(c) Post-concussion headache.[17]

CASE 29. At the time of his fracture twenty months previously, this man also suffered an extensive laceration of the scalp over the left eye. This resulted in frequent severe headaches over the left eye, associated with lachrymation, which disappeared during neostigmine therapy and have not recurred.

Cases Which Failed to Show Significant Improvement on Neostigmine Therapy. Of the twelve patients with chronic disability following fractures which failed to improve significantly from neostigmine therapy, four obtained some definite improvement from drug treatment.

CASE 7. (Table I.) On neostigmine, the patient noted disappearance of the sharp pains in the right arm which had previously awakened him from sleep. There was no change in range of motion or strength.

CASE 15. (Table I.) This man showed significant improvement in range of passive motion of the right shoulder from neostigmine, but no change in strength or pain.

CASE 35. (Table II.) This man had a severe injury of the right lower extremity with fracture of the lower third of the femur four months before, which had necessitated amputation below the knee. External skeletal fixation had been used for immobilization. A moderate limitation of extension at the knee disappeared during neostigmine therapy but there was no change in knee flexion. This appears to be as much as could be expected in such a case because of the likelihood that

scar tissue accounted for the limitation of knee flexion.

CASE 50. (Table III.) This patient showed definite improvement in range of flexion of the trunk, flexion of the left hip and radial and ulnar deviation of the left wrist. There was an increase in voluntary power in extension of the left hip and improvement in gait.

Eight patients with chronic disability following fractures showed no change from neostigmine therapy. From an analysis of these cases, it may be possible to obtain a better definition of the type of case which is suitable for neostigmine therapy.

CASE 4. (Table I.) This patient had marked · limitation of motion of the right shoulder and right elbow seven months after fracture of the head of the radius, despite previous manipulation under anesthesia.

CASE 9. (Table I.) This man sustained a Colles' fracture twenty-seven years before. He had limitation of extension of the fingers.

CASE 10. (Table I.) This patient sustained a fracture of the distal end of the left humerus into the elbow joint seventeen months before and had limitation of motion in the elbow.

CASE 12. (Table I.) Fracture of the head of the right radius into the elbow joint was sustained eleven months before, and the right arm had been immobilized in a cast for six months. He had limitation of motion at the right elbow and wrist.

CASE 17. (Table I.) Fracture of the greater tuberosity of the left humerus was sustained two and one-half months before. He had marked limitation of motion at the left shoulder and considerable weakness in various voluntary motions of the left upper extremity.

CASE 26. (Table II.) Fractures of the middle third of the left and right tibia and fibula were sustained ten months before. The left leg was immobilized in a cast for three and one-half months, the right for five months. He had marked limitation of motion of both ankles without pain.

CASE 32. (Table II.) Fracture of the left os calcis was sustained eight months before. The roentgenogram revealed an exostosis. The heel was very painful on weight bearing and the ankle and toes showed marked limitation of motion.

CASE 44. (Table III.) This man sustained multiple fractures of the lumbar

vertebrae and pelvis eleven months before. The pelvis was distorted and some of the pelvic fractures had failed to unite. He suffered from limitation of motion and pain in the back and lower extremities.

It will be noted that four of these patients (Cases 4, 10, 12 and 17) had fractures into a joint with limitation of motion at that joint. In such cases, scar tissue in the traumatized joint frequently plays a major rôle in the limitation of motion, which may account for the failure to respond to neostigmine. On the other hand, significant improvement in range of motion from neostigmine therapy has been observed in joints in which a fracture had been sustained (Cases 2, 14, 20, 27, 28, 34 and 38). It appears probable that both muscle spasm and fibrous contracture are factors in the limitation of motion at such a joint and that the relative significance of these two factors varies from case to case. At the present time, there is no technic available to differentiate these factors with certainty in limitation of joint motion in clinical cases.

Another factor which may account for failure to respond to neostigmine was the prolonged immobilization in casts in Cases 12 and 26. One patient (Case 9) had limitation of motion for twenty-seven years and another case (Case 44) was complicated by non-union and distortion of the pelvis. The patient with a painful heel with fracture of the os calcis (Case 32) is of interest since no relief of this pain referred to the bone was observed from administration of neostigmine.

COMMENTS

Neostigmine has definite value in the treatment of chronic disability following fractures. It has resulted in increase in range of passive motion, increase in strength, decrease in fatigue and relief from pain. Improvement occurs rapidly and is retained after therapy is discontinued.

The drug has this therapeutic effect by its action on the neuromuscular mechanism. The increase in range of motion and relief from pain is secondary to the relaxation of muscle spasm and contracture. The increase in strength and diminution of fatigue is the result of facilitation of transmission of nerve impulses. Neostigmine is a specific inhibitor of the enzyme cholinesterase, thereby allowing accumulation of acetylcholine at nerve endings and synapses.[2] Through this mechanism, by its action on the central nervous system, neostigmine inhibits muscle spasm and facilitates voluntary contraction of skeletal muscle.[14] The relative importance of the action of neostigmine at the myoneural junction in therapy for neuromuscular dysfunction following fractures remains to be elucidated.

The striking improvement obtained with neostigmine therapy in this series of cases of chronic disability following fractures demonstrates the important rôle that neuromuscular dysfunction plays in such chronic disabilities. As a result of fracture, trauma to soft tissues, immobilization and disuse, abnormal reflex patterns become established which may continue for a long time after the initiating factors have been eliminated. The neuromuscular dysfunction once established, may itself become the major factor in the disability and remain resistant to therapy. The genesis of and mechanisms involved in neuromuscular dysfunction resulting from trauma provide a fruitful field for investigation.

One of the notable effects of neostigmine in this series of cases has been the relief of pain. Neostigmine has not been considered an analgesic,[2] yet pain referred to joints as well as muscles has disappeared during neostigmine therapy in patients with chronic disability following fractures and the pain did not recur after treatment was stopped. An analysis of this effect indicates that the relief of pain by neostigmine is secondary to the relaxation of muscle spasm by the drug. No relief of pain occurred in a case of pain referred to bone (fracture of the os calcis, Case 32). One patient (Case 45) developed an acute subacromial bursitis while receiving neostigmine therapy and suffered severe pain

in the shoulder; at the same time, pain in the back and shooting pains down the leg were greatly relieved by the neostigmine. One patient in this series (Case 23) with a chip fracture in the left radiohumeral joint had relief from muscular pain but the pain and tenderness localized in the left radiohumeral articulation was uninfluenced by neostigmine therapy. The pain of acute rheumatoid arthritis has not responded to neostigmine.[5] One patient observed recently was relieved of low back pain and muscle spasm but showed no relief from an associated sciatic pain. Neostigmine combined with morphine was not significantly more effective in raising the pain threshold of the skin than morphine alone.[16] These observations indicate that neostigmine is not an analgesic drug. Relief of pain in joints as well as muscles in cases with chronic disability following fractures has usually been accompanied by increase in range of passive motion and relaxation of muscle spasm. It is known that muscle spasm can produce pain[18,19] and neostigmine has been shown to inhibit muscle spasm in poliomyelitis,[3] arthritis,[4,5] acute "stiff neck,"[7] acute and chronic backache[8] and in disability resulting from trauma.[5]

Strength of voluntary motion against resistance has increased rapidly in many cases of chronic disability following fractures during neostigmine therapy. While the relief from pain and increase in range of motion were undoubtedly reflected in increased voluntary power, the increase in strength observed cannot be accounted for solely on this basis. In a number of instances, rapid improvement in strength has been observed in motions at joints which showed no limitation of motion or pain. Of particular interest is the fact that strength of voluntary motion may be rapidly restored to normal during neostigmine therapy in muscles which have undergone obvious atrophy from disuse, in spite of the fact that the atrophy had undergone no evident change during the period of neostigmine administration.

SUMMARY AND CONCLUSIONS

1. Fifty-one cases of chronic disability following various types of fractures of the upper extremity, of the lower extremity, and of the vertebrae have been treated with neostigmine. The average duration of the disability in these cases was over eleven months.

2. Seventy-six per cent of these patients have shown significant improvement in the disability from several weeks of daily injections of neostigmine and atropine. The improvement was uniformly retained after therapy was discontinued.

3. Neostigmine therapy resulted in increase in range of passive joint motion, increase in strength, relief from pain and improvement in fatigue. Pain referred to joints as well as to muscles has been relieved by neostigmine.

4. In twenty cases, daily injections of saline as a placebo for one week failed to produce improvement in the disability.

5. Neostigmine results in improvement in chronic neuromuscular dysfunction following fractures by relaxation of muscle spasm and contracture, thereby increasing range of passive motion and relieving muscular and joint pain; and by facilitating voluntary muscular contraction, thereby increasing strength and diminishing fatigue.

6. The therapeutic value of neostigmine in the treatment of chronic disability following fractures emphasizes the important rôle of neuromuscular dysfunction in these disabilities.

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DIABETIC AMPUTATIONS[*]

AMPUTATION OF LOWER EXTREMITY IN DIABETICS—ANALYSIS OF 128 CASES

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IN the decade 1934–1943, there were 128 major amputations of the lower extremity for diabetic gangrene at the Israel Zion Hospital, Brooklyn. These included both private and ward cases and were performed by a number of surgeons. All the patients were carefully supervised medically and the metabolic and peripheral vascular status appraised and controlled. Every effort was made to save the extremity in each case; and occasionally amputation may have been delayed, in chronic cases particularly, beyond the optimum time for such procedure. Gangrene resulting from major vascular occlusion by embolus is not included in this study.

MORTALITY

Table 1 gives the distribution of the cases in their various age groups and by years. There were forty-two deaths, a 32.8 per cent hospital mortality. No patient failed to survive the actual anesthesia or operation. It is of interest to note that the mortality in the age groups 40 to 49, 50 to 59, and 60 to 69, was essentially the same in nine, forty, and fifty-five cases, respectively. It is only in the 70 to 79 year decade that there appears to be an appreciable increase in the mortality. A study of the yearly mortality revealed surprising variations, 63 per cent in 1934 (eleven cases), 50 per cent in 1936 (ten cases), 7.6 per cent in 1939 (eleven cases), 11 per cent in 1942 (nine cases), and 45 per cent in 1943 (twenty cases). It is important to bear this observation in mind in evaluating results of special services, anesthetics, medications, or physical therapeutic agents in this condition.

SEX

Sixty-two and five-tenth per cent of the cases were women, 37.5 per cent were men. The age distribution and mortality were essentially the same in both sexes in this series.

TABLE 1
A. YEARLY MORTALITY STATISTICS

Year	Total No. Cases	No. of Deaths	Mortality, Per Cent
1934	11	7	63
1935	9	2	22
1936	10	5	50
1937	21	6	28.5
1938	10	3	30
1939	11	1	7.6
1940	15	5	33
1941	12	3	25
1942	9	1	11
1943	20	9	45

B. MORTALITY IN VARIOUS AGE GROUPS

Age Group	Total No. Cases	No. of Deaths	Mortality Per Cent
40–49	9	3	33
50–59	40	12	30
60–69	55	17	30.9
70–79	22	9	40.9
80–89	2	1	50

DIABETES

Various authors[8] have stated or demonstrated that the underlying pathological condition is arteriosclerosis of the larger and medium vessels, with the main disorder in the media, though also appearing in the intimal layers of the vessels. The process is essentially the same as in non-

diabetic arteriosclerosis, but the effect of diabetes is to advance the process a decade. In Table II, the duration of the diabetes in ninety-nine cases is given. In sixty-six cases there was known diabetes from five to fifteen years. In only eight cases was the diabetes less than one year in duration. The diabetes was severe and difficult to control in nine patients who recovered. There were two deaths from diabetic coma and ketosis, and one in which there was severe toxemia with high blood sugar. Four other patients who died had severe diabetes which, however, cannot be considered a direct cause of death. Diabetes *per se* was a problem in sixteen instances or 12.5 per cent of the cases and the principal cause of death in 2.3 per cent. Most of the cases were mild diabetics of long standing that responded readily to treatment. This experience is similar to that reported by others.[12]

TABLE II

DURATION OF DIABETES IN YEARS

Age	1 Year or Less	2	3	4	5–10	11–15	15–20	21 or More
40–49	3	..	1	..	1	..	1	
50–59	1	..	1	1	9	15	3	
60–69	3	1	1	3	8	19	9	2
70–79	1	..	..	..	4	8	2	
80–89	..	..	..	..	..	2		
Total No. Cases.....	8	1	3	4	22	44	15	2

BILATERAL AMPUTATIONS

Nine patients had had previous amputation of the other lower extremity from six months to six and one-half years prior to the present operation. Eight were females and one was male. There was one death. Six wounds healed by primary union; one had minimal wound infection and one was grossly infected. This is a result contrary to the ordinary expectation and yet is similar to the relatively good results quoted by others in instances of bilateral amputation.[16]

ASSOCIATED ILLNESS AND EFFECT ON PROGNOSIS

About one-third of the cases had no associated clinical illness. The remainder had hypertension, cardiovascular, cerebral, and generalized arteriosclerosis, nephritis, or previous amputation of the other extremity. The mortality rate of those with advanced cerebral or generalized arteriosclerosis, and nephritis was particularly high. Hypertension *per se* did not contribute to increased mortality.

PRELIMINARY SURGERY AND ITS EFFECT ON MORBIDITY AND MORTALITY

By preliminary surgery is meant incision and drainage or minor amputation performed in the hope of controlling the infection or gangrene. Many cases re-

TABLE III

Preliminary Operation	No. of Cases	Re- cov- ered	Mortality	
			Num- ber	Per Cent
Incision and drainage, one or more times.....	19	13	6	31.5
Previous toe amputation ± incision and drain- age...................	26	17	9	34.6
No preliminary surgery..	83	56	27	32.5

TABLE IV

RELATIONSHIP OF LENGTH OF PRE-AMPUTATION HOSPITALIZATION TO MORBIDITY AND MORTALITY

Days in Hospital before Amputation	No. of Cases	Mortali- ties		Post-op. Hospital Days			
				25 Days or Less		More than 25 Days	
		No.	Per Cent	No.	Per Cent	No.	Per Cent
5 or less.....	48	11	22.9	27	56.3	10	20.8
6–10........	23	9	39.1	11	47.8	3	13.1
11 or more...	57	22	38.5	19	33.5	16	28.0

sponded and are excluded from this study. Those cases which subsequently required major amputation and those amputated without preliminary surgery are shown in Table III.

Preliminary surgery had no apparent effect on the mortality rate. Other authors have advocated preliminary surgery as a step in decreasing mortality.[25]

admission. The time periods were arbitrarily chosen. A further discussion of the mortality factors will be given later.

TYPE OF OPERATIVE PROCEDURE AND STUMP MORBIDITY

Table V presents an analysis of the type of amputation and the fate of the stump.

A. *Thigh Amputations.* There were

TABLE V

Type of Amputation	Type of Case	No. of Cases	Primary Union		Minimal Infection or Skin Necrosis		Gross Infection or Necrosis		Revision Necessary	
			No.	Per Cent	No.	Per Cent	No.	Per Cent	No.	Per Cent
Closed mid or lower thigh; not drained	Infected	36	18	50	8	22	10	27	1	2.7
	Clean	7	6	85	1	14	0	0	0	0
	Total	43	24	55.8	9	20.9	10	23	1	2.3
Closed mid or lower thigh; drained	Infected	27	2	7	8	29	17	63	3	
	Clean	7	2	28	4	57	1	14		
	Total	34	4	11.7	12	35	18	52.9	3	8
Open thigh	Infected	3	..	....	..	....	3	100		
Leg, closed; not drained	Infected	7	2	....	3	....	2			
	Clean	3	1	....	..	....	2			
	Total	10	3	30	3	30	4	40	2	20
Leg, closed; drained	Infected	6	..	....	1	....	5			
	Clean									
	Total	6	..	....	1	16.6	5	83	1	16.6
Leg, open	Infected	9	..	....	2	....	7	....	6	
	Clean	1	..	....	..	....	1		.	
	Total	10	..	....	2	20	8	80	6	60

Twenty-two cases, nineteen thigh and three leg cases, were excluded because death occurred before the local condition of the stump could be evaluated.

We realize that these figures are subject to errors of sampling and that the series is relatively small. It is, however, interesting to note the better results in cases amputated within five days after hospital forty-three circular amputations without drainage. Primary union resulted in twenty-four (55.8 per cent), minimal wound infection or necrosis in nine (20.9 per cent) and gross infection or wound necrosis in

ten (23.2 per cent). Revision was necessary in one case. Of thirty-four circular amputations with drainage, primary union resulted in four (11.7 per cent), minimal infection or flap necrosis in twelve (35.2 per cent), and gross infection or flap necrosis in eighteen (52.9 per cent). Revision was necessary in three cases (8.8 per cent).

The number of leg cases subjected to closed amputation are too few for deductions, but the trend is the same as in the thigh amputations. Primary union and lack of gross infection are more likely in undrained cases. In general, there was a higher tendency to gross infection as compared with thigh amputations. The inci-

TABLE VI

Time of Operation in Minutes	Spinal Anesthesia (60 mg. procaine)				General (N$_2$O and Ether)			
	15 or Less	16–30	31–45	46–More	15 or Less	16–30	31–45	46–More
No. of cases.	5	33	4	1	7	44	8	9
Pulmonary complications	1	1			1	6		
Cardiac	1	2		1	1	2	1	
Cerebral	2				6		1	
Coma		3			2		1	
Circulatory collapse					1			
Abdominal distention		1				1	1	
Number and per cent of mortalities	3 60%	8 24%	0%	1 100%	3 42%	16 36%	2 25%	2 22%

111 cases are in this analysis; seventeen cases are excluded because of lack of data.

B. Leg Amputations. There were ten closed cases without drainage in which there was 30 per cent primary union, 30 per cent minimal infection and 40 per cent gross infection. Revision was necessary in two cases (20 per cent). In six closed cases with drainage, there was gross infection in five (83 per cent) and revision was necessary in one case (16.6 per cent). In the open leg operations, ten cases resulted as follows: minimal infection—healing by granulation fairly clean, two cases, 20 per cent; gross infection or flap necrosis, eight cases or 80 per cent. Revision was necessary in six cases or 60 per cent.

Further detail as to relative results in clean or infected cases are indicated in Table v.

In summary, 55.8 per cent of the undrained thigh cases and 11.7 per cent of those drained resulted in primary union. Gross infection occurred in 23.2 per cent of the undrained cases and in 52.9 per cent of the drained cases. There seems to be little doubt that better results are obtained by omitting drainage of the wound.

dence of amputation revisions is much higher both in clean and infected cases and is particularly noticeable with the open operation. The mortality was slightly higher than in the thigh amputation group, the gross mortality in the thigh amputations being 32.2 per cent (thirty-two cases in ninety-nine amputations) and 34.5 per cent in the leg amputations (ten in twenty-nine cases).

Five Gm. of sulfanilamide has been deposited in the depths of the stump in all cases for the past few years. It is our impression that there has not been significant improvement in wound morbidity as a result of this procedure.

ANESTHESIA, LENGTH OF OPERATION AND POSTOPERATIVE COMPLICATION

Every patient survived the immediate operative procedure and anesthesia despite the poor general condition of many.

There were two postoperative pulmonary complications in forty-three spinal anesthetics (4.6 per cent) and seven in seventy general anesthetics (10 per cent). The

other complications noted were probably incidental. Certainly the duration of the operation within the limits studied above was not a factor in the ultimate outcome. The mortality in the group with spinal anesthesia was 27.9 per cent and in the group with general anesthesia was 32.8 per cent.

of complete mental orientation, apathy and anorexia.

Table VII presents the distribution according to this scheme. Thirty-six cases were toxic and had considerable local infection on admission. There were nineteen deaths, 52 per cent mortality. Thirty-six cases had gross infection, but no clinical

TABLE VII
MORTALITY RATE AND RELATIONSHIP TO TOXEMIA

General Status of Patient	No.	Toxic on Admission			Developed Toxic State under Treatment			Total No. Died	Mortality Per Cent
		No.	No.	Died, Per Cent	No.	No. Died	Per Cent		
1. Toxic Cases									
A. Mixed Cases—circulatory impairment and infection....	64	32	17	53	31	15	48	32	50
B. Infection—No significant circulatory impairment......	9	4	2	50	5	2	40	4	44
C. Occlusive gangrene—no infection................	3	1	1	100	2	2	100	3	100
Total................	76	..	..	...	..	..	...	39	51
1. Non-toxic Cases									
A. Mixed Cases..............	31	..	..	...	..	...	...	2	5.8
B. Infection—no significant circulatory impairment........	3	..	..	...	..	..	...	0	0
C. Occlusive gangrene—no infection................	18	..	..	...	..	..	...	1	5.5
Total...............	52	..	..	...	..	..	...	3	5.9

FACTORS INFLUENCING MORTALITY

Age, sex, yearly mortality incidence, effect of diabetes, type of operations performed and relationship of anesthesia and duration of the operation were mentioned above. The patients are now grouped according to their general condition prior to operation and the type of local lesion. They are divided into those with gangrene due to inadequate circulation, infectious gangrene with adequate circulation, and mixed cases, that is, circulatory impairment and superimposed infection. The presence or absence of toxicity is noted, whether present on admission or developing while under treatment. "Toxic" is used in a general clinical sense to describe a state characterized by dehydration, lack

toxemia on admission. These developed toxemia while under treatment. Seventeen died, 47 per cent mortality. Thirty-four cases with gross infection were not toxic at any time. Two died, 5.8 per cent mortality. In eighteen cases of circulatory gangrene with no infection or toxemia there was one death, 5.5 per cent mortality. There were three other mortalities. These were in cases of occlusive gangrene without infection; one was toxic on admission and two developed delayed toxemia

Summarizing the entire group, ninety-five cases presented both infection and evidence of circulatory impairment, twenty-one had advanced circulatory impairment with no infection, and twelve had infectious gangrene but adequate circulation. Thirty-nine of seventy-six patients who were

toxic died; 51 per cent mortality. Of fifty-two patients who were not toxic, three died, 5.9 per cent mortality.

The specific principal causes of death in the forty-two cases were the following: (1) Chronic toxemia from infected gangrenous extremity or subsequent stump infection, eleven cases. In addition, the following complications occurred in this group: two had parotitis and decubitus, one myocardial failure, one uremia and psychosis, one bronchopneumonia and one cerebral accident. (2) Anaerobic infection, seven cases, 63.6 per cent of all anaerobic infections; (3) acute myocardial failure, coronary sclerosis or thrombosis, six cases; (4) acute postoperative toxemia and hyperthermia, five cases; (5) pulmonary complications, five cases; (6) cerebral accident, three cases; (7) nephritis, two cases, and (8) diabetes, three cases.

Improved end results will follow only when toxemia can be effectively controlled. The main cause of toxemia is infection. It must be remembered, however, that there will always be some deaths because of advanced degenerative disease so common in these patients. The deaths from coronary thrombosis, cerebral vascular accident, and nephritis comprising eleven cases in this series fall in this group. The problem of pulmonary embolism and postoperative bronchopneumonia (five cases) is the same as in all operative problems involving the aged. Better control of infection in the local area may be a factor in decreasing pulmonary complications. However, it is probable that some incidence of pulmonary complication will persist. The same may be said for the occasional severe uncontrollable diabetic.

If mortality will be reduced, we believe that the cases that will respond are those in groups 1, 2, and 4. These comprised eleven deaths from pyogenic infection, seven due to anaerobic infection and five due to a severe postoperative toxemia with hyperthermia, probably with infection as the basis of reaction.

In recent years the sulfonamides were used freely in these infected cases with indifferent results. The advent of penicillin will probably permit the control of toxemia by reducing or controlling simple pyogenic and anaerobic infection in these seriously sick patients.

Eight major amputations for diabetic gangrene were performed from January to September, 1944. Five patients were sixty to sixty-nine years old and three were from seventy to seventy-five years old. Three patients were toxic and five were not. Six had lower thigh and two upper leg amputations. Penicillin was used in five cases. Three healed *per primum*, two had minimal infection and three gross infection. All the patients recovered.

SUMMARY AND CONCLUSIONS

1. One-hundred-twenty-eight cases of diabetic gangrene requiring major amputation are presented.

2. The mortality rate in non-toxic cases (fifty-two) was 5.9 per cent for toxic cases (seventy-six) 51 per cent a total mortality of 32.8 per cent.

3. The most important single factor influencing toxicity was infection.

4. Adequate control of infection, either by chemotherapy or by earlier amputation, will lower mortality.

5. Drainage of amputation wounds increases the incidence of wound infection and prolongs morbidity.

6. In this series, those patients with thigh amputations had less wound morbidity than those with leg amputations. Since many of these patients will never wear a prosthesis effectively, efforts to salvage a better stump by amputation below the knee court unnecessary risks and are usually of no avail.

7. Major amputation is a relatively safe procedure under spinal or general anesthesia. Actual operating time, within reasonable limits, is not a contributing factor to mortality.

8. The diabetes in the majority of cases is readily controlled.

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A TOWEL FOR USE IN THIGH AMPUTATIONS

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A SIMPLE, inexpensive, efficient towel to drape the thigh during amputations is described here. Its value, patients at the Cook County Hospital where thigh amputations are frequently performed.

FIG. 1. Towel is cut one-half way through at center with circle about 1 inch in diameter cut out of center; strips are sewed as indicated

FIG. 2. After the muscle has been separated by the surgeon, and the bone is ready to be sawed through, the towel is applied by placing it around the bone and tying center ties of towel so that the knot is on the side of the cut muscle.

FIG. 3. The towel is then folded over the proximal stump and the other two ties are made.

particularly as a retractor, has been satisfactorily demonstrated on a number of

Material. The material necessary consists of an ordinary 26 inch by 18 inch

towel as used in surgical procedures, and three triple thickness strips of toweling $\frac{1}{2}$ inch by 24 inches. The towel is cut one-

seam about $\frac{1}{2}$ inch wide. One of the $\frac{1}{2}$ inch by 24 inch strips is sewed to the toweling around the center opening. The

Fig. 4.

Fig. 5.

Fig. 6.

Fig. 4. This will shape the towel to the proximal stump. An assistant can now retract the muscle by placing his fingers through the finger openings of the towel as indicated.

Fig. 5. The surgeon may now saw the bone without interference from protruding muscle, instruments or assistant's hands.

Fig. 6. After the bone has been sawed, the towel is removed by simply lifting it off the stump.

half way through at center, with a circle about 1 inch in diameter cut out of the center; the edges are folded to form a

other two strips are sewed to the towel around a circle of about 11 inches in diameter and so placed that finger open-

ings are present between the strips and the towel itself as seen in Figure 1. This completes the towel.

Application of Towel for Amputation. After the muscle has been separated by the surgeon, and the bone is ready to be sawed through, the towel is applied by placing it around the bone and tying the center ties of towel so that the knot is on the side of the cut muscle.

The towel is then folded over the proximal stump and the other two ties are made. This will shape the towel to the proximal stump.

An assistant can now retract the muscle by placing his fingers through the finger openings of the towel as indicated in Fig. 4. The surgeon may now saw the bone without interference from the protruding muscle, instruments or assistant's hands. After the bone has been sawed, the towel is removed by simply lifting it off the stump.

DÉBRIDEMENT is the very antithesis of primary wound excision. Wound excision is a meticulous process, often time-consuming, and only to be carried out soon after wounding. Débridement simply implies enlargement of the wound in order to effect free drainage combined with rapid removal of foreign bodies and obviously dead tissue.

From "Surgery of Modern Warfare" edited by Hamilton Bailey (The Williams and Wilkins Company).

TREATMENT OF FINGER FRACTURES, SIMPLE AND COMPOUND*

FINGER AMPUTATIONS

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INJURIES involving the fingers, with or without fractures, are very common. This is particularly true in industrial communities where obviously a large portion of the working population is associated with various types of factory work, involving the use of hands in the many machine operations. The fingers represent an exposed portion of the hand, subjected to the many necessary trauma hazards which may be minor or major in character. Industrial full time surgeons of the several large automobile factories located in Flint, Michigan, agree as to the frequency of such accidents. It has been the writer's privilege to see many of the severe finger fractures and their resultant disabilities, in a consulting capacity, occurring in these plants. Much of the discussion in this presentation evolves from this direct association with the prob'em industrially, as well as from the clinical material presented in a large fracture service at Hurley Hospital, Flint, Michigan, over the past twenty years. The importance of this type of injury is stressed in all of the standard monographs on fracture management by such prominent authors as Kellogg Speed, Wilson and Cochrane, Paul Magnuson, Key and Connell, Watson Jones, etc. The subject is given prominence in the excellent volume "Surgical Anatomy" by J. Latimar Collander.

Fractures of the fingers may be simple or compound, single or multiple, complete or incomplete, transverse, oblique, with all degrees of comminution. They may involve joints, show minimal or marked displacement, and be associated with all degrees of soft tissue injuries.

The etiology, for the most part, is the compression type of injury. Less frequently are the workman's finger ends actively or passively projected against the injuring mechanism. Finger fractures are basically the same as fractures of other long bones. The anatomy varies only in that the epiphysis is at the proximal end. The cortex, medullary canal, and cancellous portions are identical. Osteogenesis is the same. The functions of neighboring joints are just as important. Physiotherapy measures have the same indications. Stiffened joints produce restricted or complete disability. Secondary localized osteomyelitis and necrosis may occur. Delayed and nonunion may be present.

Management is commonly neglected or inadequately done by those of the medical profession who are not fracture minded. Experienced industrial surgeons who are constantly associated with these injuries, and who recognize the importance of a satisfactory result, are most careful and painstaking in their care. Thus, for the most part, the results are very satisfactory. Surgeons of trauma who obviously have many fractures problems are well aware of the importance of good results. The importance of x-ray examination in all suspected fractures, and before and following reduction, is emphasized.

Distal Phalanx. This is the most frequent site of finger fractures. These frequently involve the tips and are of the

squashing comminuted type. Most times there is no significant displacement, and management is by use of a straight splint in a position of extension, until there is satisfactory clinical and radiographic union. There are no rules in fracture healing time, but an arbitrary period of about three weeks is sufficient, followed by physiotherapy if necessary. This is not solid union and, of course, progresses for months. Flouroscopic observation, during manipulation and reduction, is most helpful although not necessary. If there has been an evulsion of the extensor communis digatorum tendon at the base, a drop finger results and immobilization should be secured in hyperextension to fulfill two requirements: healing at the tendon attachment, and healing of the fracture. If the fracture is beyond the attachment of the flexor profundus tendon, the proximal fragment is pulled down and immobilization following reduction in flexion is indicated. If the fracture extends into the joint, immobilize in extension using a straight splint. Joint motion is urged as soon as satisfactory beginning union occurs. The hazard of disturbed joint function is obvious.

Middle Phalanx. The flexor digitorum sublimus muscle ends in a tendon which is divided into two parts, inserted one on each side of the mid portion of the phalanx. The resultant deformity will depend upon the location of the fracture. If the site is distal to the tendon insertion, there is a flexion of the proximal segment, and a dorsal displacement of the distal segment. Alignment is secured by curving the digit over a roller bandage or Davis ball. When the fracture site is proximal to insertion of the tendon, there is a flexion deformity of the distal segment with the proximal portion remaining in an extended position. Immobilization in a straight splint is thus obvious, following alignment of the distal part with the proximal. Failure to observe the principles involved in these two types fails to correct the deformity. Spine formation may develop and interfere with flexion

of the distal phalanx. Three weeks immobilization is usually sufficient for beginning union. Physiotherapy follows, directed toward restoration of neighboring joint function.

Proximal Phalanx. The deformity occurring in fractures of the proximal phalanx is quite constant regardless of the site of the fracture. This consists of a palmar angulation of the fracture site due to pull of the interosseous and lumbrical muscles on the proximal fragment, and a dorsal displacement of the distal segment. Here again the displaced fragment must be brought into line with the proximal one and secured in a flexed position, either by use of a curved splint Davis ball or a roller bandage. Continuous traction can be accomplished in this position by use of narrow adhesive tape strips along the lateral surface of the digit, attached to the surface of the ball or bandage, or extended upward and attached to the flexor surface of the wrist. With several proximal phalangeal fractures and malignant overriding, continuous traction is indicated, employing the use of the "banjo splint," transfixed in a plaster of Paris wrist bandage at the base of the wire loop.

Thumb. The thumb is a most important unit in hand function because of its association with grasp and pick up, and obviously satisfactory union of its fractures must occur. Fractures of the phalanges are managed in the same manner as the fingers. The first metacarpal is an important part of this digit. It is in reality a proximal phalanx. Its epiphysis is proximal as are the epiphyses of the phalanges. Fracture dislocations are perhaps the most common type of injury. Faulty union will produce an atrophy of the muscles of the thenar eminence and there will be a weakness of grip. The extra articular fractures may be simple or compound, transverse, oblique, and longitudinal with comminution. Simple fractures predominate. In all of these the fixation should maintain a position of extreme abduction and may be retained thus by the use of plaster of Paris

applied as a spica. In the event of marked upward dislocation of the shaft, as occurs in a Bennett's fracture, there must be an overcoming of the displacement and longitudinal traction is therefore indicated.

Fractures of all phalanges with severe evulsion and non-reducible fragments by normal manipulation and traction procedures require open reduction. The fixation agents are optional, governed by the discretion of the surgeon. In compound fractures, care of the wound is of prime importance. If seen early, closure without tension is indicated. If seen late, leave open and pack lightly with vaseline gauze. The bone should be covered. Associated tendon injuries are obviously repaired. Osteogenesis will be slower in compound fractures, and secondary complications of osteomyelitis and necrosis occasionally occur with residual disabilities more frequent. Local and general chemotherapy both prophylactically and therapeutically are indicated in the selected case.

Padded tongue blades, wooden applicator adhesive splints, direct skeletal traction, by wires through the finger tips and supplemental wire loop attachment to a plaster of Paris wrist forearm bandage, fixed transfixion pins employing the adjacent digits and plaster of Paris encasement, specialized traction and curved adjustable metal finger splints, etc., are contained in the bag of fracture tricks to be used by the surgeon who cares for these injuries.

It is to be noted that the underlying principle in all finger fractures of matching the mobile distal segment to the less mobile proximal one is plain. This would seem to simplify the given essentials of management and relieve the surgeon of remembering mechanical details from various deformities. In the various types of immobilization attention should be constantly kept in mind concerning disturbance of circulation by a constricting portion of the apparatus. Frequent observations during the process of healing and restoration of neighboring joint function should be

made until the maximum of use has been obtained. It is only by this chronic enthusiasm that some of the badly mangled fingers can be restored to a degree of function that may be satisfactory to the individual in pursuit of his occupation.

AMPUTATIONS

The common causes for finger amputations are trauma, deformity, or infection. If after painstaking management of a badly damaged finger, there is a resultant disability which renders the digit useless and inhibits maximum function of the remaining fingers and hand, amputation is to be considered. In severe, freshly traumatized fingers the surgeon's obligation is to save as much as possible. The reparative processes are great. If the soft parts are destroyed, it is evident that amputation is indicated. Continuous pain from permanently damaged nerves, complete tendon loss, and joint fixation with deformity are among the indications. Complete agreement between the surgeon and patient is demanded. The question of the patient's desire for amputation on the basis of obtaining financial reimbursement must ever be borne in mind, but in the vast majority of cases, election of amputation will be based upon a disability evaluation that is honest.

If the disability involves the index finger and is complete, with involvement of all joints, amputation is best done in the mid metacarpal area. This insures a better muscle pad and cosmetic result. The second finger then assumes the functions of the first. If the little finger is likewise involved, the same procedure is indicated for the same reasons. If the middle and third fingers are involved, amputations are advised in preference to disarticulations. Disarticulations give unsatisfactory results anywhere. There is almost always a returning function of the metacarpal phalangeal joints and they should never be sacrificed. A short finger stump maintains the knuckle line, aids grip, and prevents

the V-deviation of the adjacent fingers. These principles are likewise true with the thumb. Grasp is the most important function of the hand, with pick up in second place. If the injuries are massive and involve all fingers, maintenance of parts of these functions is definitely indicated. *Save as much as possible.* Long plamar and short dorsal flaps are preferable.

SUMMARY

An attempt has been made to cover the essential principles of the assigned subject. Cases are obviously individualized and management must be conservative and concentrated. By attention to the essential details of this problem, many subsequent plastic and reconstruction operations are eliminated.

Case Reports

POSTOPERATIVE HERNIA FOLLOWING ABDOMINAL PERINEAL RESECTION

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AN attempt to review the literature reveals only one reference to post-operative perineal hernia following abdominal perineal resection for carcinoma of the rectum. The Cumulative Index refers only to Yeomans' article in Transactions of the American Proctologic Society, 1937, in which he reports a case of postoperative hernia in a female patient. The discussion by McKenney following this report refers to two cases of perineal hernia following abdominal perineal resections, both of which were in females. All of the above three female patients had had abdominal surgery of the reproductive organs years previously. The first one had been operated thirty-five years previously. The second one had had two laparotomies twenty-five years previously and a hysterectomy twelve years prior to the resection. The third patient had a hysterectomy twelve years before the resection.

Hayden reports two cases both in male patients: one, a large hernia, the contents of which could not be reduced; the other, a small reducible hernia. An attempt was made to give these patients some external support. He reports neither a very great success. Dr. D. F. Jones, of Boston, with over 800 resections, has not seen a single case of hernia. The above reports were taken from the Transactions of the American Proctologic Society, 1937. Dr. Dixon, of the Mayo Clinic, told me in March, 1944, that he had seen two postoperative hernias and operated upon both with immediate results good. Dr. Bacon told me he has just recently seen two in patients of his, but not following abdominal perineal resections.

CASE REPORT

In view of the few cases reported in the literature, I wish to present a case of postoperative perineal hernia which to me has been most interesting from many angles.

The patient was referred to me by a practical nurse, a friend of his wife. He had been seeing his family doctor every week for six months, at which times he would have his abdomen palpated and receive another handful of pills. He had never had a rectal examination. He was first examined by me on July 6, 1943.

Physical examination revealed a white male, fifty-four years old, born in Czecho-slovakia, and employed as a common laborer in a steel factory. Examination revealed head and neck normal. Lungs revealed good expansion, normal resonance, normal breath sounds, no râles. Heart examination revealed apex one finger inside mid-clavicular line; cardiac sounds regular, weak and slow, not exceeding 60. Slight systolic murmur at the apex, and blood pressure 125/70. The abdomen was soft with no distention. No tumor masses were palpable; there was no tenderness or rigidity. There were no inguinal glands, and liver, spleen and kidneys were not palpable. Rectal examination revealed numerous skin tags and loss of perianal fat. Digital examination revealed the prostate slightly enlarged and of normal consistency. Above the prostate was a hard indurated area on the anterior wall with elevated edges, movable and apparently not attached. Anoscopic revealed bloody mucus filling scope and large primary and secondary

hemorrhoids. The lower margin of the mass could be seen and appeared to be a cauliflower-like growth. Proctoscopic revealed the mass

FIG. 1. X-ray of colon showing large deformity and filling defect of rectum.

about 6 cm. in diameter with ulcerated center on the anterior wall of the rectum. Sigmoidoscope passed full length under direct vision revealed no abnormalities above the rectum.

His chief complaint was of twelve to fifteen stools during a twenty-four-hour period, nocturia, and the loss of thirteen pounds during the past six months. His bowels had always been regular until December, 1942, when he first noticed an increase in the number of stools per day with definite changes in characteristic, these frequent stools being thin and watery and always containing blood, both dark red and bright. He also noticed cramps in the lower abdomen before stools with relief following defecation. His past history was normal except for a right inguinal hernia repaired in 1938. The family history was non-contributory.

The patient entered the hospital on July 7, 1943, where a barium enema was given and x-ray of the colon revealed a large deformity and filling defect of the rectum, possibly carcinoma. (Fig. 1.) Otherwise, the colon appeared normal. The blood count was as follows: Hemoglobin 65; red blood cells 3,300,000; white blood cells 6,700. Differential leucocyte count showed segmented cells 65, young cells 2, lymphocytes 30, and monocytes 3. Urinalysis showed specific gravity 1,018 with many pus cells and a trace of

albumin. He was hospitalized for six days to prepare for surgery. Preparation included high-caloric, low-residue diet; morning saline
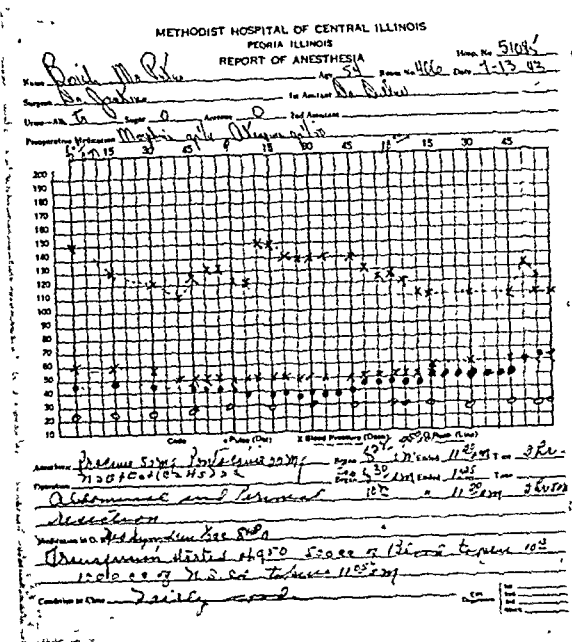
FIG. 2. Report of nurse anesthetist.

laxative daily; evening enema daily; no sulfa drugs administered by mouth. On July 11th, he was given 500 cc. of citrated blood. His pulse rate during this hospital stay varied from 40 to 60. Blood chemistry, such as is routinely done, including serum protein (a–g ratio), serum bilirubin and serum prothrombin, were omitted since the hospital at this time was without the services of a chemist.

On July 13, 1943, abdominal perineal resection was done in one stage and a retention catheter left in the bladder. At the patient's request, spinal anesthesia was used, 50 mg. of procaine in 0.5 cc. spinal fluid followed by 50 mg. pontocaine in 2 cc. 10 per cent glucose. A left paramedian incision was made to above the umbilicus. Liver and gallbladder were normal and no glands were palpable along the aorta or in the iliac region. There was no evidence of peritoneal involvement. The growth was below the peritoneal reflection and mobile. The superior hemorrhoidal vessels were ligated and dissection was made posteriorly down to the sacrococcygeal articulation. The anterior dissection was very difficult as the bladder was firmly attached to the growth. In attempting to separate the bladder from the rectum, a small perforation occurred just above the prostate with the escape of some gas. A purse-

string suture closed this perforation and the dissection was stopped. The lateral ligaments on each side were ligated lateral to two small
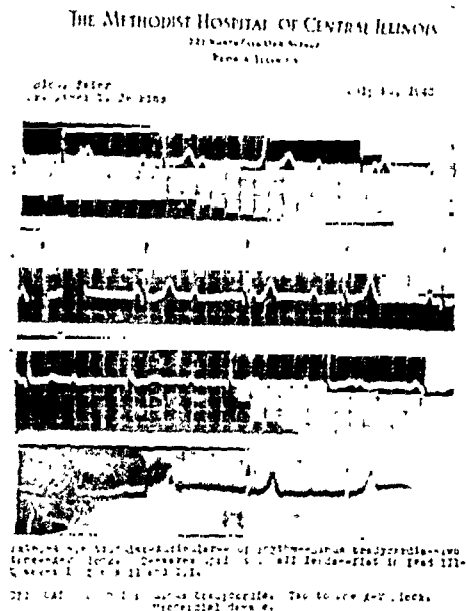
FIG. 3. Electrocardiogram made on the sixteenth postoperative day showing heart block and myocardial damage.

(pea size) glands and cut. De Martel clamp was applied to the sigmoid, the bowel was separated with cautery, and the distal loop dropped in the hollow of the sacrum. The peritoneal reflections were easily approximated and closed with continuous chromic catgut sutures, rebuilding the pelvic floor without tension. The umbilicus was excised and the proximal loop brought out in this area. Peritoneum and fascia were closed with interrupted steel alloy wire sutures, sulfathiazole powder was distributed subcutaneously, and the skin was closed with skin clips. The wound was dressed with Elastoplast bandage.

At this point, the patient complained of discomfort, and cyclopropane was administered. He was turned on his abdomen and the anus was closed with purse-string sutures and posterior dissection was carried out. The coccyx was excised, fascia propria opened, and the clamp and distal loop were delivered posteriorly. The dissection of the bladder and prostate was continued, and with considerable difficulty; the removal was completed without further perforation. Five Gm. of sulfathiazole powder were distributed in the area and a rubber tissue sheet was placed in the posterior cavity, which was packed with

gauze. During this procedure, the patient received 500 cc. citrated blood followed by 1 000 cc. of 5 per cent glucose in saline.

The pulse rate during surgery varied between 40 and 70, never getting above 70. (Fig. 2.) The total time of operation was two hours and fifty minutes, which is too long. Loss of time was due to inexperience of student nurses and doctors, time loss in turning and preparing patient for posterior resection, adherence of bladder to tumor mass, perforation, .etc. The heart block and myocardial damage in this patient were not felt to be a contra-indication for surgery, as the carcinoma was surely to be the cause of his death if not operated upon.

Anatomical diagnosis was found to be papillary adenocarcinoma of the rectum with metastasis to local perirectal lymph nodes. Histology revealed the "A" section showing a malignant epithelial growth such as is usually observed in the rectum. At one point it had completely penetrated the wall and had infiltrated for a short distance into the attached fat tissue. The epithelium differentiated into irregular acinar formations whose cells were the tall columnar variety. Most of the cells had an acidophilic cytoplasm and a few had differentiated into goblet cells. About two cells per high power field were in mitosis. In the "B" section there was a penetration of all layers of the bowel wall. The "C" preparation through the lymph nodes showed hyperplastic lymphoid tissue and in one place there was an infiltration by tumor of the variety seen in the primary mass. The "D" lymph node showed only hyperplastic lymphoid tissue. The "E" section was also from hyperplastic lymph node and showed no evidence of tumor.

Postoperative reaction was uneventful on the first postoperative day, when he was given 500 cc. citrated blood as well as 2,000 cc. of 5 per cent glucose in saline. The clamp was removed from the stoma forty-eight hours postoperatively, and at seventy-two hours, the patient had a bowel movement via the colostomy. On the fourth postoperative day, half of the posterior cavity packing was removed, with complete removal on the fifth day. The wound was clean, there was some sloughing of tissue, the cavity was irrigated daily with potassium permanganate solution, and treated with sulfathiazole powder applied by means of a powder blower. The retention

FIG. 4.

FIG 5.

FIG. 6.

FIGS. 4, 5 AND 6 Three views of the hernia taken with patient in knee chest position showing hernia reduced, partly reduced, and completely protruded.

catheter was removed on the sixth postoperative day and the patient voided thereafter. The following day he was catheterized for retention and 60 cc. of urine were obtained.
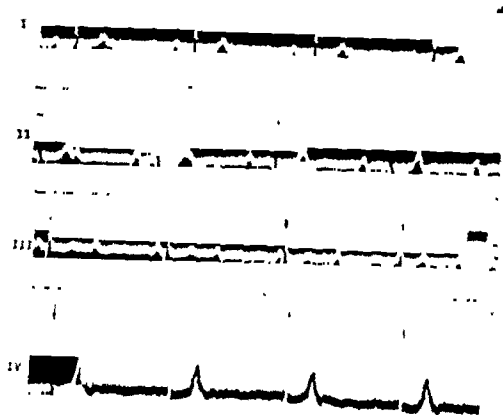
FIG. 7. Electrocardiogram thirteen months postoperatively showing heart block.

By the seventh postoperative day the colostomy was functioning daily without irrigation. The abdominal wound was dressed and the clips removed. Elastoplast as an outer dressing keeps the skin clean and dry; it is an ideal dressing, being waterproof as well as supportive. Uneventful convalescence continued, wounds were clean and healing normally, patient voiding and having a daily normal bowel movement via the colostomy. He was up on the twelfth postoperative day and his temperature was normal. Pulse variation remained between 40 and 60, urine contained 25 pus cells per high power field, erythrocyte count and hemoglobin were within normal limits, and leucocyte count was 19,000. On the next day, temperature was 101°F. and there was an increase in the number of pus cells in the urine, but no retention. The posterior cavity appeared to be granulating normally and was being irrigated daily. Sulfathiazole was administered orally, 15 gr. four times daily. The following day his temperature went up to 104°F. Sulfathiazole determination in the blood reached a level of 3 per cent and medication was stopped. Inspection of the posterior cavity revealed some excess granulation with bridging across high in the hollow of the sacrum. This was broken down with a gloved finger and daily irrigations continued. This may have been the origin of our hernia.

On the fifteenth day, temperature was down to normal, patient was up and about and the urine was clear again. This reaction and the temperature of 104°F. were probably due to a pus pocket or infection in the posterior area of the bladder and the reconstructed pelvic floor, inasmuch as the blood sulfathiazole level remained low and the urine cleared up immediately. An electrocardiogram on the sixteenth day revealed the heart block as described previously, ventricular 43, auricular 86. (Fig. 3.) The pulse rate during the three febrile days remained between 50 and 60 per minute.

At this time, the internist suggested that ephedrin, gr. 3⁄8 at three-hour intervals, might release the heart block. This was given for forty-eight hours, when the patient refused to take any more as it kept him awake. His pulse rate remained between 40 and 60 during his entire stay in the hospital of twenty-five days. The surgical shock, the temperature of 104°F. and the ephedrin every three hours had no effect on the pulse rate, which never went above 68 during the entire time.

The patient went home 25 days after admission with the abdominal wound healed, the colostomy functioning daily without irrigations at any time, the posterior cavity granulating normally, and with the urine clear and voiding normally. The posterior cavity irrigations were to be continued at home every two days, followed by the insufflation of sulfathiazole powder. He was seen in the office six weeks postoperatively and improvement continued normally. He returned to work eight weeks postoperatively as store clerk in the tool department. The posterior cavity was not completely healed, as the skin edges were not approximated, but apparently granulation was complete otherwise.

Three months postoperatively, healing was complete in the posterior area as well as the abdominal incision. The patient was feeling fine and was back to his former weight. He was having a daily bowel movement without an enema, nocturia once or twice nightly, and the urine was clear. Examination one month later revealed the colostomy stoma large enough to admit the index finger. There was no evidence of hernia in the abdominal wall. The posterior area was completely healed, and there was a slight bulge on standing at the sacral end of the scar. There was no pain at any time. One month later, the bulge on

coughing was considerably larger, involving about half of the posterior scar. The patient was informed of the condition, but he felt painting his house on the outside. He had lost no time from work and felt fine. The colostomy was functioning daily with no help.

FIG. 8. Cystogram, anteroposterior view, with hernia protruding.

FIG. 9. Cystogram, anteroposterior view, with hernia completely reduced.
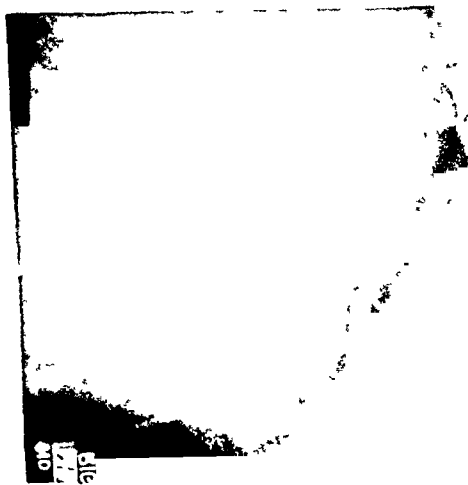
FIG. 10. Cystogram, lateral view, with hernia protruding.

FIG. 11. Cystogram, lateral view, with hernia completely reduced.

fine and had worked constantly with no discomfort in any area.

He returned two months later with the entire posterior cavity bulging on standing. When placed in the knee-chest position, the hernia reduced itself. By this time the hernia was quite large, but the patient still had no complaints and could see no reason why anything should be done as it was not bothering him. (Figs. 4, 5 and 6.) Sitting was just the same as ever. When seen next time, one year postoperatively, the patient had just completed

At the present time, the hernia is about the same as it was four months previously. It is no larger, as it fills the entire pelvis on straining and reduces when lying down. On straining, the skin is taut and looks as though it would burst. The patient says, "It does not bother me, so why worry about it?" The patient's pulse rate remains the same. An electrocardiogram made thirteen months postoperatively by Dr. Durkin reveals no change except perhaps increasing myocardial damage. (Fig. 7.)

Not being clear on what fills the posterior cavity in these parts with the removal of the rectum, levator muscles, etc., it was decided to take cystograms in the anteroposterior and lateral positions, thinking the bladder might have prolapsed posteriorly into the hernia. However, this was proven not the case, as the bladder remains in normal position. (Figs. 8, 9, 10 and 11.) With the hernia reduced, the prostate is easily palpated through the skin.

SUMMARY

1. A white male patient with a large palpable carcinoma of the rectum had been treated for six months without ever having had a rectal examination.

2. The same patient withstood a prolonged abdominal perineal resection with a pulse rate never exceeding 70 per minute.*

3. A colostomy functioned normally without ever having had an irrigation.

4. A large postoperative perineal reducible hernia occurred which causes the patient no discomfort.

5. The bladder remains in a normal position.

6. The patient is well satisfied, has no complaints, and is unwilling to have anything done about the hernia since it does not bother him in any way.

* My choice of anesthetic for the surgery described in this paper was pentothal sodium, but the nurse anesthetist had greater self-assurance in using cyclopropane.

FEMORAL hernia is acquired and of gradual development. While some authorities think it arises always from a congenital sac or diverticulum, it is rare before the age of twenty and the femoral canal is not normally open at birth. Therefore, it may be considered an acquired condition. The swelling is usually small, rounded or globular, the neck lying inferior and lateral to the pubic spine and the inguinal ligament.

From "Principles and Practice of Surgery" by W. Wayne Babcock (Lea and Febiger).

UNUSUAL FOREIGN BODY IN RECTUM*

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MANY reports of foreign bodies in the rectum have appeared in the literature which we do not propose at this time to review exhaustively. It is well known that in ancient times the introduction of various solid bodies was practiced as a method of punishment. Foreign bodies have been forced into the rectum with criminal assault and sometimes in depraved pranks; but more commonly are introduced by the patient himself in connection with some form of sexual perversion. There is hardly any object commonly available which has not been recovered from the rectum either by manual extraction from below or by laparotomy.

Among the objects that have been reported are: a snuff box, whiskey glass, a 30 cm. mortal pestle, a bullock's horn 11 inches long, electric light bulbs, an ink bottle, a vaseline bottle, a cold cream jar and lemon, an apple, chicken bones, glass tube, portion of a broom handle, frozen pig's tail, a stick measuring 32 cm. in length, a cylindrical candle box 6 inches in circumference and 2¼ inches in length, a tool box containing a piece of gun barrel, a screw driver, two hacksaws, a boring syringe, a file, several coins, thread and tallow. The predilection seems to be, naturally, for solid cylindrical objects easily accessible at the time that the individual resorts to preversion when under alcoholic or sexual compulsion.

Entirely apart from foreign bodies introduced through the anus, foreign bodies may enter the rectum from above following their ingestion often without a distinct history so that they are accidentally discovered in the course of routine rectal examination. Most common are the animal or fish bones which become caught in the lower rectal or anal tissues.

This is a case report of an unusual foreign body removed from the rectum and sigmoid colon. The object was a plantain, a member of the banana family, about nine inches long, which the patient had encased in a latex rubber sheath (condom).

A plantain is a kind of banana of the genus musa parapisiaca sometimes considered as a variety of the common musa sapientum. The fruit of this plant when cooked is a staple article of food throughout the tropics. It is larger than the ordinary banana which it resembles, greenish in color, less sweet, and contains more starch.

CASE REPORT

J. R., a thirty-seven-year-old Puerto Rican male, came to the Emergency Ward of the Flower and Fifth Avenue Hospital on February 5, 1945, complaining of rectal bleeding associated with rectal and lower abdominal pain of three hours' duration. Three hours before admission, he had inserted the plantain into his rectum while under the influence of alcohol. Various attempts made by the patient to remove the foreign body were unsuccessful. Manipulations in the rectum with a pair of scissors were followed by profuse bleeding.

On examination, the temperature was 99°F.; pulse, 100; respiration, 22; blood pressure, 140/90. He was complaining of severe pain in the rectum and moderate lower abdominal pain. His breath was aromatic. Examination of the abdomen revealed no evidence of spasm or rigidity, moderate tenderness over the entire lower abdomen, no rebound tenderness, distention, nor evidence of free fluid. A rigid mass, compatible in shape with that of a large banana was palpable in the lower abdomen. On rectal examination, a considerable amount

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of bright red blood was encountered in the rectal ampulla. The lower end of the foreign body was easily felt and on bimanual examination was continuous with the mass felt abdominally. On proctoscopic examination, one could see what looked like the stem of a banana high in the rectal ampulla. Repeated attempts to extricate the foreign body by means of finger with pressure on the abdomen, and the use of forceps and clamps were unsuccessful, the object apparently being firmly lodged in the rectosigmoid. Failure was also due to the inability to obtain a proper hold on the stem which either slipped away or shredded when instruments were applied.

Under general anesthesia, in the operating room, with the patient in a lithotomy position, the plantain along with the encasing condom was removed via the rectal route. We were unable to obtain any grasp of the lower end of the plantain with ordinary forceps, volsella, or ring forceps. A shepherd's hook was inserted with its point protected by the finger, guiding it into proximity to the lower third of the object. The point of the hook was then forced well into the object which was held steady by the assistant's hands, pressing it downward from its abdominal end. By gentle traction with the hook, the rough lower end was gradually delivered as the folds of mucous membrane were separated with the finger. The frayed and roughened, thick stem was found incarcerated in these folds, offering the obstacle to previous efforts at extrication. Proctoscopic examination revealed numerous deep abrasions of the lower portion of the rectal ampulla and anus with deep congestion of the mucosa and some oozing but no active bleeding.

Postoperatively, the patient was given full doses of sulfasuccidine by mouth and rectal instillations of sulfasuccidine suspensions. He was observed for three days; no untoward reactions were noted, no temperature or pulse rise and no changes in abdominal signs occurred. Proctoscopic and sigmoidoscopic examinations on the third day revealed a hyperemic and edematous rectal mucosa with scattered areas of punctate hemorrhages. No other pathological condition was seen. Following psychiatric consultation, a diagnosis of a bisexual individual with a strong latent homosexual impulse was made. He was discharged for follow-up in the psychiatric clinic.

SUMMARY

This is a case report of an unusual foreign body, a plantain covered by a condom, removed from the rectum and sigmoid of a bisexual male, thirty-five years old. The difficulties encountered in the extrication were due to the slippery nature of the object, its tendency to shred at the stalk and to the catching of the rolled edges of the condom in the folds of the rectal mucosa. Recovery was uneventful; sulfasuccidine was given orally and by rectal instillations as prophylactic measures.

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TRAUMATIC LUXATION OF THE TESTIS

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WAR with its violence, speed and multitudinous mechanical appliances, causes many casualties not directly associated with combat. These are accidental injuries of great variety and varied severity. One of the rarer and unusual of these injuries recently came to our attention on the Urological Service of a Regional Station Hospital.

CASE REPORT

On December 6, 1943, a twenty-four year old soldier presented himself, complaining of the loss of both testicles. He stated that this occurred in November, 1941, while debarking at a Ferry Command Base. He was assisting in transferring cargo from a ship to a barge when he slipped and fell, landing astride the gun wale of the landing barge. Excruciating pain immediately followed in the perineum and lower abdomen, causing him to lose consciousness. During the transfer to shore, which occurred immediately, he regained consciousness and was assisted to the beach where he rested three hours. During this time a severe, nauseating, but gradually diminishing pain was present throughout the lower abdomen, and at the end of three hours he was able to assist in light work. For the next three or four days he did only odd jobs not requiring physical exertion and then returned to full duty, never seeking medical care. He was aware on the day of the injury that the testes were out of the scrotum, and reasoned that they must have been pushed into the abdomen.

He said that prior to the injury both testicles were in the scrotum. The right testicle had always been in the upper part of the scrotum and was somewhat smaller than the left, which he attributed to a herniorrhaphy at the age of five. The left testicle was, in his opinion, of normal size and in the normal scrotal position. Following the injury he did not recall ever voiding bloody urine, nor that there was discoloration of the perineum or the lower abdominal wall. In fact, in his memory, there never were

any external signs of injury except the empty scrotum. There were likewise no changes evident to him in his personality, ability to work or sexual power.

After nearly two years of full duty he was returned to the States. At the local Reclassification Center the defect was noted by the medical examiner, and he was referred to us for correction of the defect. Examination revealed a completely empty, small, contracted scrotum A transverse suprapubic scar was present slightly to the right of the midline. The right inguinal canal was empty, and the right testicle could not be found. A tender mass the size of a testicle was felt in the subcutaneous tissue over the area of the left internal inguinal ring. The remainder of the physical examination and laboratory tests were normal.

A diagnosis of bilateral luxation of the testes was made. On December 11, 1943, the left testicle was surgically replaced in the scrotum. This was done by way of the usual hernia incision. The testicle was found to be normal in size, lying over the internal inguinal ring and attached to the subcutaneous fat by many adhesions. The external oblique fascia had been split and its edges widely separated from the external inguinal ring to the position occupied by the testicle at the internal ring, thereby unroofing the inguinal canal throughout its entire length. There was no hernia.

After freeing the testicle from its adhesions to the surrounding tissue no difficulty was encountered in placing it in the scrotum for the cord was completely free and was readily drawn from the abdomen. The testicle and scrotum were then anchored to the thigh with a single suture of silk. Closure of the inguinal canal was accomplished by suturing the conjoined tendon to the inguinal ligament over the cord. After finding the separated edges of the external oblique fascia it was imbricated. Number 40 interrupted cotton sutures were used throughout. No attempt at any surgical interference was made on the right side since there was no testicle palpable and the inguinal canal appeared intact.

An uneventful convalescence followed and the patient was discharged to full military duty on January 23, 1944.

In 1936, Herbst and Polkey found ninety-two cases reported in the literature which they classified as testicular luxations. They added one case of their own. In this group they included twenty-eight cases of herniation of the testis and five cases of cryptorchidism, which we believe are not true luxations. They did not include seven cases which Dombrowsky mentioned as having seen in Russian Army Recruits in whom, with one side of the scrotum empty, a testicle was found lying in the subcutaneous tissue at the external inguinal ring, the result of self-mutilation to avoid military service. This would leave a total of sixty-seven cases. Since their review of the subject four cases have appeared in the literature, namely, the cases of Bourgeois, McRea, Ott and Shannon, making a total of seventy-one cases of true testicular luxation.

It appears to us to be confusing and incorrect to classify scrotal injuries, in which the testicle is denuded of its scrotal covering, as cases of luxation of the testicle. They have been designated as herniae testes, compound dislocations, or compound luxations by previous writers, but always included under the general topic of luxation. Some of these cases in turn were actually an avulsion of the scrotum and should not be included under either classification. They are the cases of Barthelemy et Miramond De Laroquette, Golden, Tournus des Gonets and Wolf. The subject might be greatly clarified if the designation, herniation of the testicle, was limited to those cases in which a rent in the scrotal wall has occurred permitting the testicle to lie outside of the body, devoid of its scrotal covering. Whereas, in cases of luxation of the testicle, the integument of the body remains intact and the previously normally located testicle assumes a non-scrotal position by being forcibly propelled through normal anatomical apertures or along fascial planes.

There are thirteen cases of luxation of the testis, including the one we are reporting, recorded as occurring in military personnel. Of this group there are but two bilateral luxations; the one reported by Claubry as occurring in 1809 and the present case. The total number of bilateral luxations recorded in the literature is eight. This is then not only a very dramatic but exceedingly rare injury as well.

Among the immediate causes producing luxation of the testis are accidents, such as, a run-over by heavy vehicles, falling astride an object a direct blow to the scrotum, saddle injuries, sudden severe muscular efforts, coitus, ill-fitting trusses and self-mutilation. Some of the patients may have had an underlying congenital anomaly or anomalies permitting extreme mobility of the testis which might have been a predisposing factor in the cases associated with muscular effort or coitus, but the cause, as in our case, is usually of such severity that a minor congenital anomaly is not a necessary factor.

The positions as described by Alyea to which the testicle may be dislocated are: superficial fascia of the lower abdomen, dorsum of the penis, perineum, crural area of the thigh, inguinal canal, femoral canal and abdominal cavity.

The symptoms and findings depend upon the type and severity of the injury to the surrounding tissues. These findings may vary greatly, but there is usually extreme nauseating pain with or without vomiting, an empty scrotum and except in cases in which the luxation has been into the abdomen, a tender palpable testicle in one of the areas described in a preceding paragraph.

The treatment, except in rare instances, is surgical. Early attempts at replacing the testicle have occasionally been successful without surgery. If non-surgical replacement is impossible, early surgery to replace the testicle is indicated.

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THERE is much in common between infectious and inflammatory processes and the metastases of cancer, yet there is no evidence that infection plays any part in the process except as a complication of ulcerative carcinomas.

From "Metastases Medical and Surgical" by Malford W. Thewlis (Charlotte Medical Press).

BILATERAL BRANCHIAL CLEFT CYST

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THE origin and pathogenesis of so-called congenital cysts and fistulas of the neck has long been an interesting and controversial subject. Wenglowski, in 1912, after thorough study and dissection of seventy-five embryos and 246 cadavers, propounded his theories on the origin of lateral cervical cysts and fistulas. He emphasized the fact that the branchial system begins to develop in the human embryo in the second half of the first month, and that during the second month, perhaps even in the first half, this system is lost. He believed the branchial system to be more a part of the head than the neck, and no branchial remnants were to be found below the lower border of the hyoid bone. It followed that any cysts, fistulas, or other anomalous structures below this level must be of other than branchial origin.

Bailey disagrees with Wenglowski in that he believes some cysts and fistulas which appear below the hyoid bone to be of branchial cleft origin. He points to cervical auricles and the case of a persistent branchial cartilage situated in the lower part of the neck, where a cyst usually opens, as evidence of the fallacy of Wenglowski's hypothesis. Bailey prefers to approach the subject from a clinical point of view.

Sutton says that fistulas arising from the second visceral cleft open, externally, opposite the thyrohyoid space in front of the sternomastoid muscle and, internally, in the tonsillar fossa. He further says that fistulas arising from the third and fourth visceral clefts open, externally, lower down, nearer the sternoclavicular articulation, in front of the sternomastoid muscle, and internally, in the sinus pyriformis.

Peterson, in his exhaustive and excellent review of the subject of congenital cysts and fistulas of the neck, mentions that Dr. Franklin R. Carter has operated successfully on a case of bilateral congenital fistulas of the neck. Pictures of the patient and the specimens are included. In a review of the literature, as complete as the tactical situation in a theater of operations will permit, I am unable to find another case of successfully operated bilateral congenital fistulas of the neck and, consequently, I report this as an unusual case.

I do not feel qualified to enter into a discussion of the origin of this fistula and cyst, but, in this case, both sides opened, externally, at the level of the thyrohyoid space and 3 cm. lateral and, internally, both opened in the tonsillar fossa. According to Sutton's description, then, these fistulas originated from the second visceral cleft.

Although the origin of these cysts and fistulas is very debatable, the treatment which gives the most uniformly good results is radical surgical excision. Cutler and Zollinger have recently reported several cases in which the patients were treated with sclerosing solution with good results. The case to be presented was treated by bilateral surgical excision, one side at a time, and the result is excellent at this time, seven months later.

CASE REPORT

The patient, a male, age twenty-eight years, entered this General Hospital March 1, 1944, after having been injured in an automobile accident in which he incurred a laceration of the forehead 2 inches long and a small linear fracture of the outer table of the skull in the frontal region. His recovery from his injuries was very rapid, and we were asked to see him because of a draining fistula on each side of the neck.

The patient's history was entirely negative, except for the usual childhood diseases and a tonsillectomy at the age of twenty-four. At

eight years of age the fistulas of the neck were first noticed but gave little trouble except that the one on the right began to drain a small

suture. A small amount of mucoid material was aspirated, and then the fistula was filled with a mixture of lipiodol and mineral oil in equal
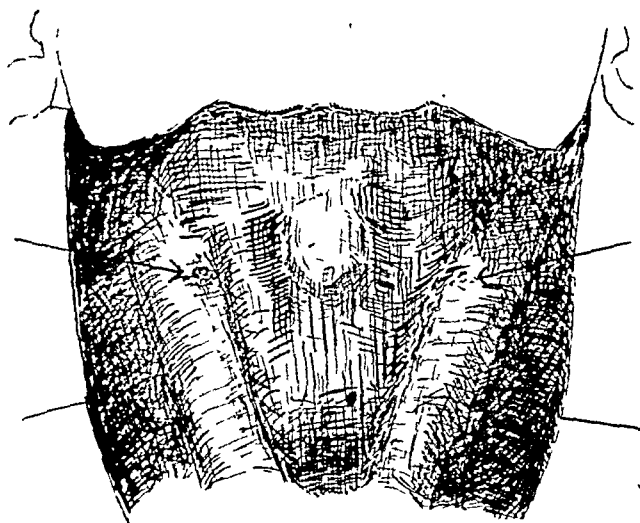
FIG. 1. Arrows indicate external fistulous openings.

amount of mucoid material and had continued to do so right up to the time of examination. The fistula on the left side gave no trouble until the patient was twenty-one years old, when it began to undergo periods of inflammation, suppuration, and drainage, interspersed with periods of quiescence. Twice it had to be opened. At the time the patient entered the Army, it was in a quiescent phase, but it had suppurated twice since then. The patient was put on a limited duty status due to the continually draining sinus on the right and retained this status up to the time of this examination.

General physical examination of the patient on March 15, 1944, was entirely negative except for the neck. Examination of the neck (Fig. 1) revealed, on the right side, a 3 mm. opening at the level of the thyroid cartilage and 3 cm. lateral to it, which exuded a mucoid secretion continuously. There was no tenderness on palpation, but on applying downward pressure, it was thought a cord could be felt running upward and medially. On the left side, instead of an opening, there was a dimple of comparable size. Above and around this dimple was an area of induration and tenderness. Both sides moved slightly with deglutition.

On March 16, 1944, the patient was taken to the x-ray department and an intravenous cannula was introduced into the opening on the right side and held in place by a purse-string

parts, and an x-ray was taken. At the time of the injection the patient complained of a bitter taste in his mouth, and the x-ray revealed the
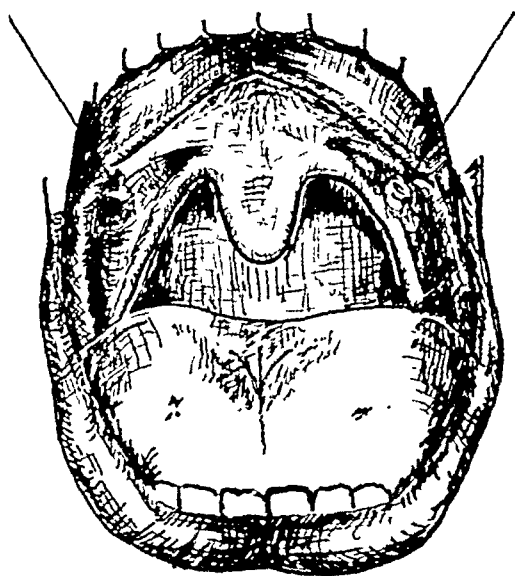
FIG. 2. Arrows indicate internal fistulous openings in tonsillar fossae.

mixture to have traveled upward and medially to a point just below the mandible, and then posteriorly, a total distance of 4.5 cm. Similar examination of the left side was impossible due to the presence of infection. It was decided to

delay operating for ten to fourteen days because of the recent skull fracture and the presence of the inflammation on the left side.

method of Von Hacker. The subcutaneous tissues were closed with plain No. 0 catgut and the skin with silk. A small piece of latex tissue
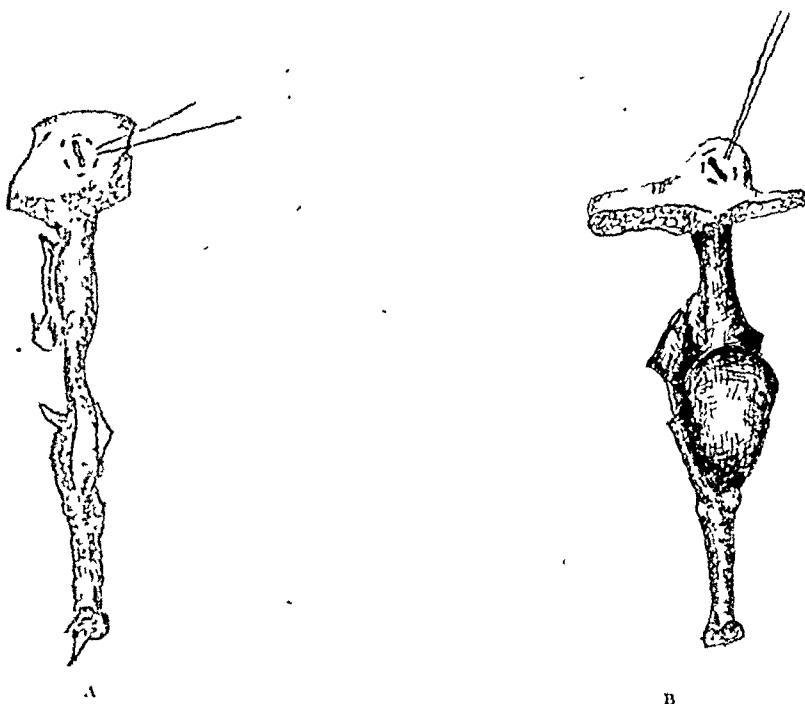
FIG. 3. A, fistulous tract from right side; B, cyst and fistulous tract from left side.

It was also decided to do one side at a time. Hot, wet dressings were applied to the left side, and the induration rapidly disappeared.

On April 2, 1944, under pentothal anesthesia, an intravenous cannula was again introduced into the opening on the right side, methylene blue introduced by injection, and the opening secured by a purse-string suture. (It is believed that inhalation anesthesia using an intratracheal tube is the anesthetic of choice in these procedures. This was avoided because of the straining and coughing incident to this procedure in the presence of a recent skull fracture.) An elliptical incision 5 cm. in length was made around the orifice and the tract, which was about 0.5 cm. in diameter, was dissected free past the medial border of the sternomastoid muscle, thence to the carotid sheath as far as the bifurcation of the common carotid artery, and then laterally under the posterior belly of the digastric muscle and the twelfth (hypoglossal) nerve. At this point a finger was placed in the mouth and a probe guided into the pharynx through the fistula, and into the posterior portion of the tonsillar fossa. (Fig. 2.) All, save 0.5 cm. of the tract was then cut off, and the remainder was inverted into the pharynx by the

drain was introduced into the depth of the wound. The drain was removed on the second postoperative day, the sutures on the fourth day. (Fig. 3A.)

On April 7, 1944, an identical procedure was carried out on the left side. (Fig. 3B.) This side was slightly more difficult, technically, because of the many previous episodes of inflammation and the presence of a 1.5 cm-cystic dilatation of the tract 1 cm. from its origin. The specimens were drawn immediately after surgery in both cases.

Pathological study of both these specimens showed them to be lined by a rather flat, squamous epithelium, surrounded by areolar tissue, and a moderate amount of lymphoid tissue. The specimen from the left side showed the result of its previous episodes of inflammation in the presence of fibrous tissue and the cells of chronic low-grade inflammation.

The patient left the hospital on April 25, 1944, reclassified to a full duty status, and has just reported to me by letter (seven months later) that he has had no soreness, no difficulty of any kind, and considers himself completely well.

SUMMARY

1. The conflicting theories of the pathogenesis and origin of lateral cervical cysts and fistulas are presented.

2. The diagnosis, x-ray findings, and surgical management of a case of bilateral branchial cleft cyst are reported.

3. The patient is completely well after seven months.

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THYROGLOSSAL cysts not infrequently become infected and are incised and drained. Such treatment may be indicated to control infection, but will not effect a cure. Complete excision of the cyst with the thyroglossal tract is the only curative treatment. Excision up to the hyoid bone is not sufficient. The dissection should be continued to the foramen cecum.

From "Operations of General Surgery" by Thomas G. Orr (W. B. Saunders Company).

VISIBLE GUIDE FOR NAILING INTRACAPSULAR FEMORAL NECK FRACTURES*

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IN the so-called "blind" method of internal fixation of intracapsular femoral neck fractures, the surgeon is confronted square steel bar (C), which is at right angles to the collar (A). The guide rod (D) is attached to the upright bar by means of
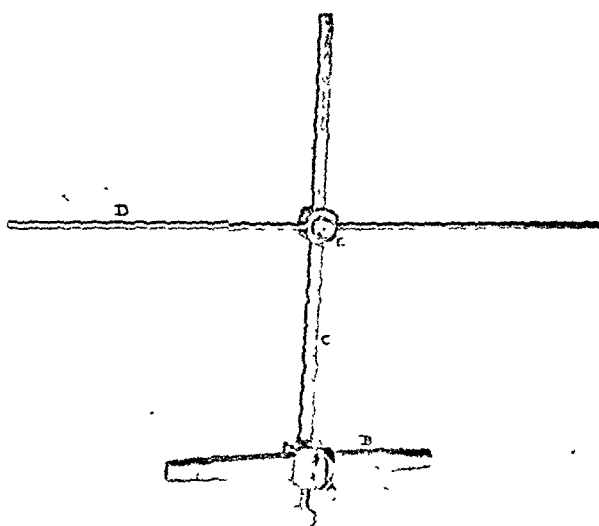
FIG. 1. Instrument assembled ready for use.

fronted with the problems of determining the course of direction the nail should take prior to its insertion and guidance of the nail during insertion. The apparatus herein described is presented because of its simplicity, accuracy, and ease of application.

The purpose of the instrument designed by the author is twofold: (1) Determination of direction, and (2) visible guide during insertion.

The apparatus as shown in the accompanying photograph (Fig. 1) consists of a chromium plated steel collar (A), which is fixed on the nail driver (B) by two set screws. From this collar there extends a

a clamp (E), which is fitted with two set screws, which allow for raising or lowering the guide rod, or moving it medially or laterally, depending upon the size of the patient.

When this instrument is attached for use, the guide rod and driver are parallel to each other, in a vertical plane and are maintained in this position throughout the operation. In addition to being parallel, the guide rod also is in true alignment with the point of the nail and the center of the driver in its longitudinal axis, thus assuring accuracy in nailing.

* From the Surgical Service of Beckman Hospital, New York.

The use of the apparatus presupposes proper reduction of the fracture before proceeding. In the use of the direction finder a grid consisting of one-half inch wire mesh 4 inches by 4 inches with lead numbers attached, is placed on the skin over the anterior aspect of the inguinal region, so that the center of it bisects Poupart's ligament. This grid is held firmly in place by several Michel clips, or silk sutures to the skin, and kept in full view of the operator. An x-ray is now taken and the position of the femoral head and neck can be noted with respect to the numbers on the grid as shown in the accompanying x-ray photograph. The grid was first used at the Beekman Hospital by Dr. Donald Gordon, Dr. S. A. Siegel, and Dr. L. V. Marrone. However, any other type of skin indicator may be used in place of the grid in conjunction with the visible guide.

The usual incision is made along the lateral aspect of the upper end of the femur and the bone exposed. A point is selected

means of a center punch at this point on the shaft of the femur, which represents the point of entrance of the nail. The
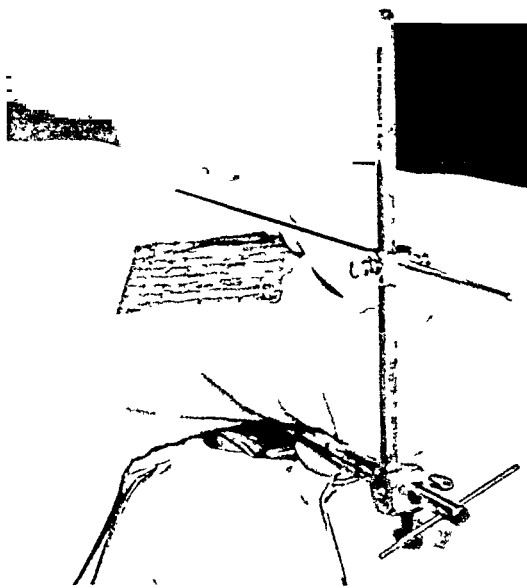
FIG. 2. Instrument in actual use (nail partly in femur).

assembled guide as shown in the photograph is now ready for use in the following
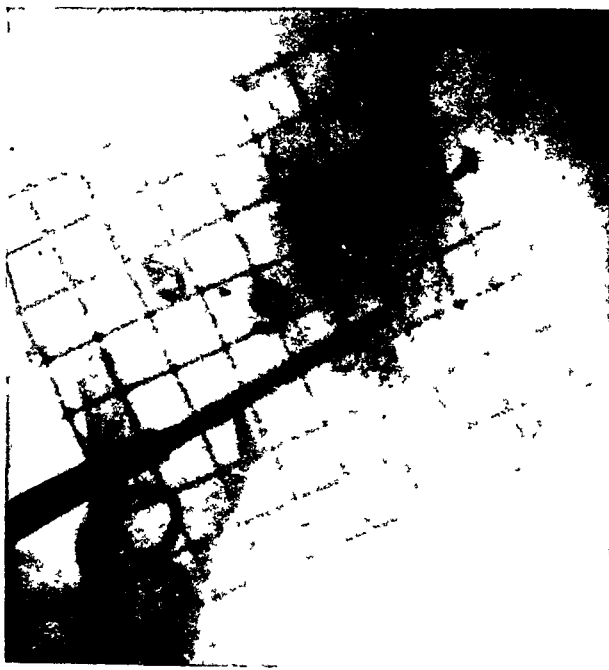
FIG. 3. Nail partly in femur; guide rod superimposed and in direct line with nail indicating its course.

on the center of the shaft about 3/4 to 1 inch below the inferior edge of the great trochanter. A punch mark is made by

manner: The point of the nail is placed on the shaft of the femur at the center punch mark; the guide rod is now placed

along the course indicated by the numbers on the grid; all set screws are then made tight, and with the apparatus held firmly with one hand the nail is driven into place.

shortening of operating time, and conservation of x-ray film. It may be used with any of the various types of nails by substituting the respective driver.

A   B
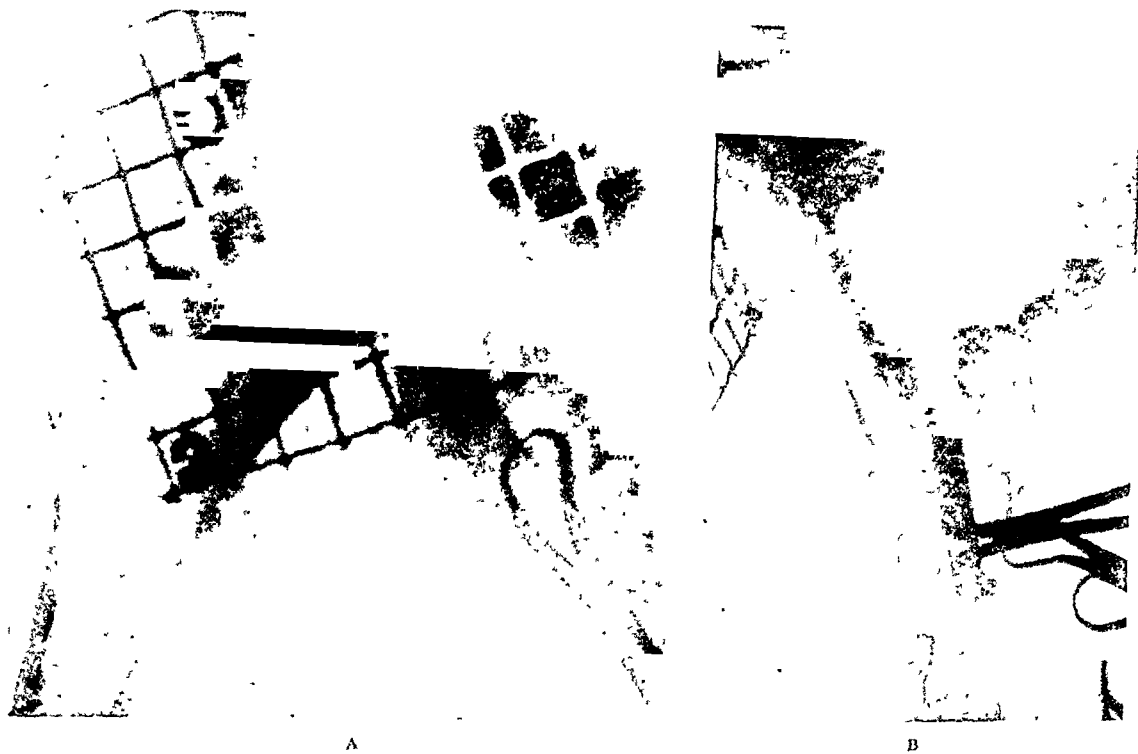
Fig. 4. A and B, anteroposterior and lateral views of nailing completed.

A check-up x-ray may be taken when the nail has been driven about one-half its length. On this x-ray it will be noted that the guide rod and nail are parallel, and in alignment, thus enabling the surgeon to complete the nailing under vision of the guide rod, assuring proper direction. The wound is closed in the usual manner. Operative asepsis is not endangered by the use of the direction finder, due to the fact that no additional instruments such as wires or Steinman pins are introduced into the wound.

The visible guide has been used on six cases at the Beekman Hospital with marked success resulting in more accurate nailing,

The apparatus as shown has been adapted for use with the Smith-Petersen and Dooley type of nails.

SUMMARY

A new instrument* has been presented to facilitate accurate nailing of intracapsular femoral neck fractures, which possesses the following advantages: (1) Direction and course of the nail are visible to the operating surgeon. (2) No part of the guide apparatus enters the operative wound. (3) Operating time can be shortened. (4) It eliminates repeated x-ray check-up plates.

*This instrument is manufactured by Edward Week & Co., Inc., Brooklyn, N. Y.

COLOSTOMY CLAMP

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THIS clamp (Fig. 1) has been in use for eight years ànd has proved its value in: (1) early decompression of tomy before firm adherence to abdominal wall.

Application. After the wound has been
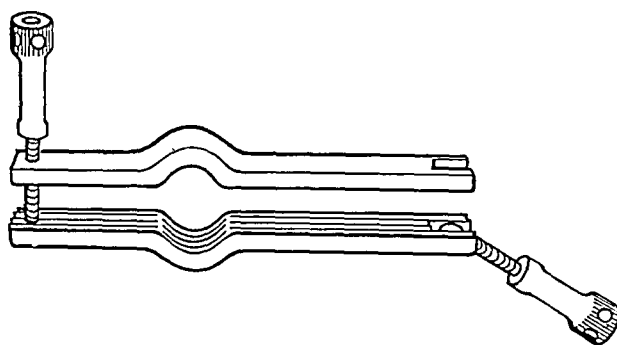
FIG. 1. Clamp consists of two blades, each with a half circle depression. These are held in place by two set screws, one of which is hinged, and whose heads contain small holes for the insertion of a pointed instrument to facilitate the tightening.
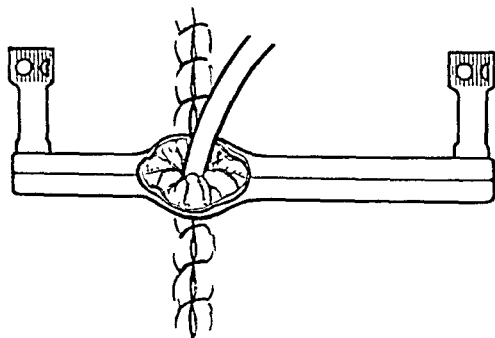
FIG. 2. Clamp appled to single barrelled colostomy.
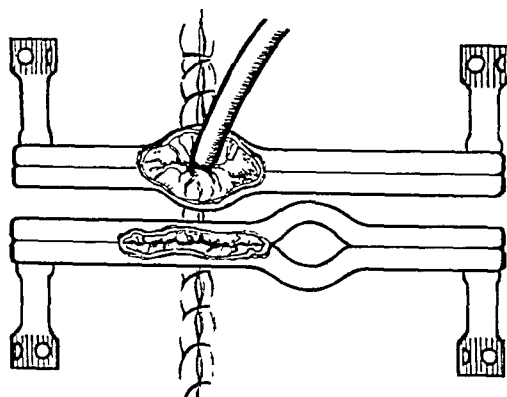
FIG. 3. Clamp appled to double barrelled, Mikulicz or Devine colostomy.

an obstructed bowel with an absence or decrease in bowel distention, nausea, vomiting and ileus; (2) permitting early ingestion of fluids and food; freedom of movement with comfort and safety of the patient; (3) preventing danger of bowel perforation by catheter inserted through bowel wall below ordinary clamp; soiling of wound by bowel contents being diverted through catheter for several days; tearing of bowel by accidental traction of long handled clamp; retraction of short colos-

closed and covered with vaseline gauze, the bowel is grasped with Allis forceps on each side below the clamp with which the bowel is closed; the colostomy clamp is slipped beneath this first clamp with the curved section approximating the bowel lumen. Flat gauze sponges are placed between the colostomy clamp and the wound dressings. The original clamp is removed after the cauterized edge of the bowel has been grasped on each side by forceps. A lubricated. No. 24 to No. 26 mushroom

catheter with two additional openings cut in the bulb is inserted with a small forceps into the open end of the bowel just below the clamp. (Fig. 4.)

3); Mikulicz or Devine colostomies (Fig. 3); cecostomy and ileostomy. The clamp on the distal loop may be left *in situ* until the bowel sloughs. In performing a cecos-
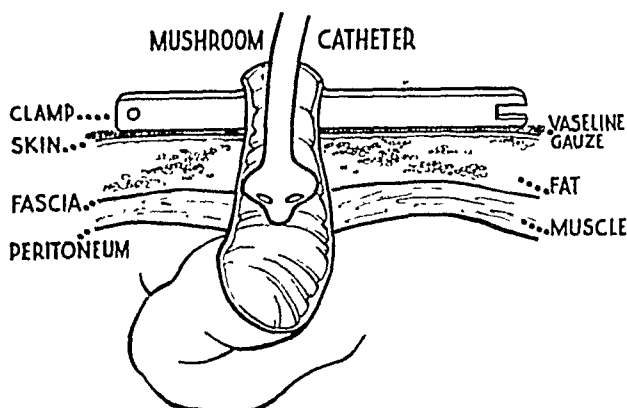
FIG. 4. Mushroom catheter in place.

The clamp (Fig. 1) is designed with the opening placed off center allowing the straight portion to be applied to the distal end of a double barreled colostomy (Fig. 3) or to the proximal end if the operator is fearful of leakage.

This clamp* is used in a single colostomy (Fig. 2); double barreled colostomy (Fig.

* The clamp may be purchased from the Ed. Holz Surgical Company, of Los Angeles, California.

tomy a fold of the bowel is drawn through the wound and held with Allis forceps, the catheter is inserted through an opening made with a cautery and the clamp tightened in place. The appendix may be removed by being included in the clamp.

The catheter is kept open by the injection of 30 cc. of air several times the first postoperative day and water the second. The Harris flush is attached on the second or third postoperative day.

NEW SELF-RETAINING RETRACTOR

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THIS retractor is a great help in the operating room in this era of man power shortage, in that it dispenses with the need of an assistant to hold retractors.

As can be seen in the illustration, the device consists of (1) a ring with numerous slots around its periphery, which circles the operative field, (2) metal spring bands which pass around the part of the body operated upon and hold the slotted ring in place and (3) chains with a hook at one end. The figure shows how the retractor is used for a mastoid operation. The ring is placed in position before the incision. After the incision is made, the hook of a chain is fastened into one side of the incision, pulled back as far as it will go and a link of the chain nearest a slot is slipped into the slot. It is held from slipping by the next link. The hook of another chain is fastened into the other side of the incision opposite the first hook, that chain is pulled taut and a link inserted into its appropriate slot. As many hooks and chains can be used as needed.

The pull of the chains from opposite directions keeps the ring from shifting sideways. There is a minimum of encroachment on the operative field.

FIG. 1. Use of retractor for mastoid operation.

This retractor can be made in various sizes and can be used on almost every part of the body.

SPECIAL ARTICLE

MALFORMATIONS OF THE UTERUS*

REVIEW OF THE SUBJECT, INCLUDING EMBRYOLOGY, COMPARATIVE ANATOMY, DIAGNOSIS AND REPORT OF CASES

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IT is now recognized that congenital anomalies of the uterus are not mere anatomical curiosities but are potentially serious conditions which warrant the careful consideration of every gynecologist and obstetrician. To the gynecologist a knowledge of these abnormalities is helpful in clarifying obscure and refractory cases of sterility or of menstrual disorder. To the obstetrician the ability to detect uterine malformation can be of great usefulness in averting dangers which threaten mother and child. Since it often happens that uterine anomaly is responsible for abortion, miscarriage, premature and difficult delivery, or uterine rupture, early diagnosis may be necessary and even urgent.

THE MÜLLERIAN DUCTS

Since malformations of the uterus are referable to developmental arrest or deviation of the Müllerian ducts, a brief review of the embryology of these structures is of practical value. During the sixth week of embryonic life, the Müllerian ducts become visible. They are directed longitudinally and are in close proximity to the more developed Wolffian ducts. The insertion of the ligamentum inguinale, which eventually becomes the round ligament, into the urogenital cord differentiates two sections in the Müllerian ducts. The segments located above this area of demarcation remain ununited and eventually form the fallopian tubes. The distal segments of the Müllerian ducts move in a medial direction and eventually lie side by side. During the twelfth to fourteenth week, the medial wall formed by the fusion of the two Müllerian ducts disappears and fusion is completed by the formation of a single medial canal—the uterogenital canal. Further differentiation results in the formation, from below upward, of the structures which develop into the vagina and uterus.

Details have been omitted in this brief description because the various stages of embryonic development are readily seen in the schematic drawing. This figure has been simplified in order to avoid confusion and to give a clear picture of the development of the uterus. (Fig. 1.)

. In view of the intricacy of the processes which result in the formation of the uterus, it is not at all surprising that frequent disturbances in development, with subsequent malformation, should result. Many theories con-
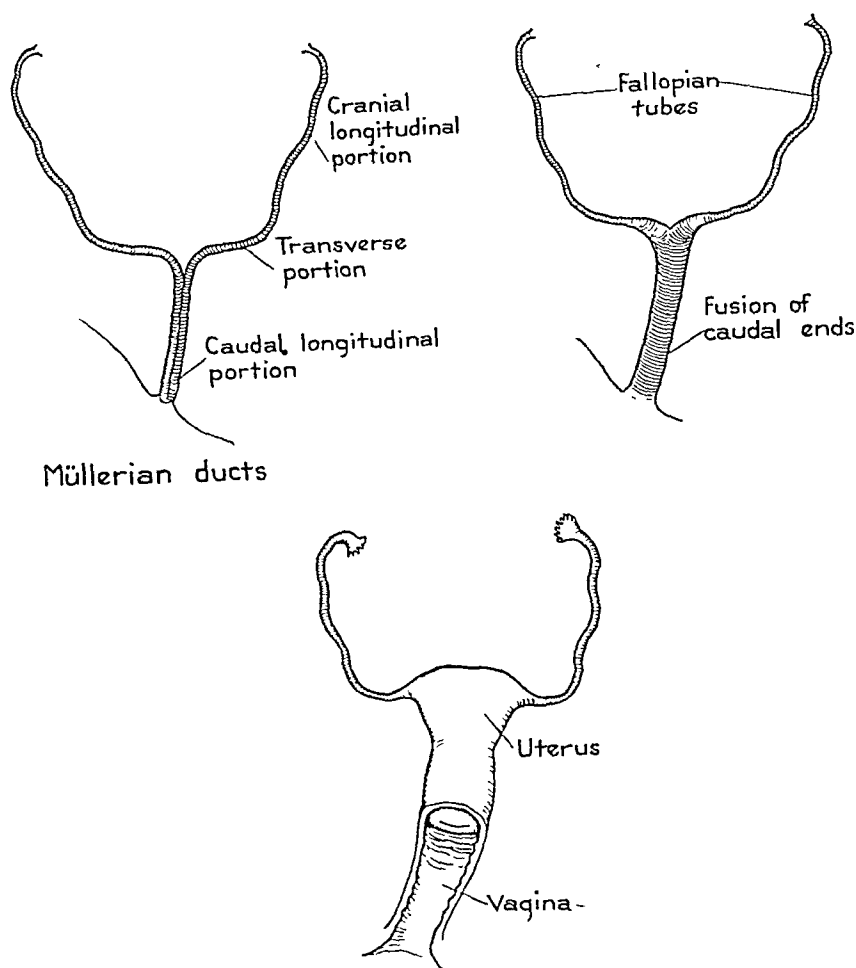
Fig. 1. Schematic drawing to illustrate the fusion of the Müllerian ducts to form the uterus and vagina.

cerning the etiology of uterine anomalies have been advanced, but, as is pointed out by Masson and Kaump, their very number suggests that proof is lacking.

Many of the earlier theories concerning the development of uterine anomalies have been concisely summarized by Granberry and Faust (1938), but it is obvious that none of them explain all the varied malformations encountered in clinical practice or at autopsy. Falls (1939) has expressed the opinion that hormonal failure in intrauterine life might be chiefly responsible for the improper fusion of the two halves of the uterus, as well as for other

developmental deficiencies in this organ. On the basis of an observation made by Felix in 1912, Anderson believes that many uterine anomalies can be explained on the ground that the left Müllerian duct usually advances slightly ahead of the right and that an error of timing during embryological development might result in a malformation.

It has been suggested that both defective germ plasm and unfavorable embryonic environment are among the most important factors in the production of malformations of the uterus (Curtis 1942; Rogers and Blocksom). However, like other experienced workers (Bailey and Miller, DeLee and Greenhill, Moncure, Braze), I am inclined to take the less complicated view that various types of uterine anomalies can be attributed to abnormal fusion or lack of fusion, in whole or in part, of the Müllerian ducts. In other cases, the anomaly of the uterus is probably due to rudimentary development of one duct, or perhaps, its almost complete suppression, as might well be the case in instances of uterus unicornis. It is, of course, quite probable that any one or a combination of unknown factors will greatly influence the degree or localization of fusion, or the lack of proper embryological development, but of this we cannot be certain. From a purely clinical viewpoint we must be on the alert to recognize the presence of such anomalies, whatever their cause, and to treat the patient in accordance with the findings.

TIME OF OCCURRENCE OF MALFORMATIONS

Through our knowledge of embryology attempts have been made to fix the time during development when uterine anomalies are most apt to occur. According to Schattenberg and Ziskind, unilateral or bilateral failure of development may occur during the first month, while uterus didelphys, with double vagina and uterus, may form during the second month, because of failure of fusion of the two sides. Arrested development on one side may give rise to a rudimentary horn. Uterus bicornis or uterus arcuatus may form during the third or fourth months because of incomplete fusion of the two Müllerian ducts. The septum may persist or a single or double cervix may develop. Schattenberg and Ziskind remark that the only malformation that occurs after the fifth month is uterus arcuatus. Although a uterus may appear normal externally, it is also quite possible that it may contain a persistent septum, which may or may not continue into the vagina to give rise to uterus septus duplex or uterus and vagina septus duplex.

TYPES OF UTERINE ANOMALIES

Between the premature uterus didelphys and the almost normal uterus arcuatus, a large number of uterine anomalies are possible. This has led to complex and unwieldy systems of classification. The early confusion of unclassified forms and varied nomenclature was partly clarified in 1922

when Kaufmann introduced his schema. This classification, modified slightly by Frank and others, remained the basic system for many years. Kaufmann divided uterine anomalies into four basic groups, each of which had several
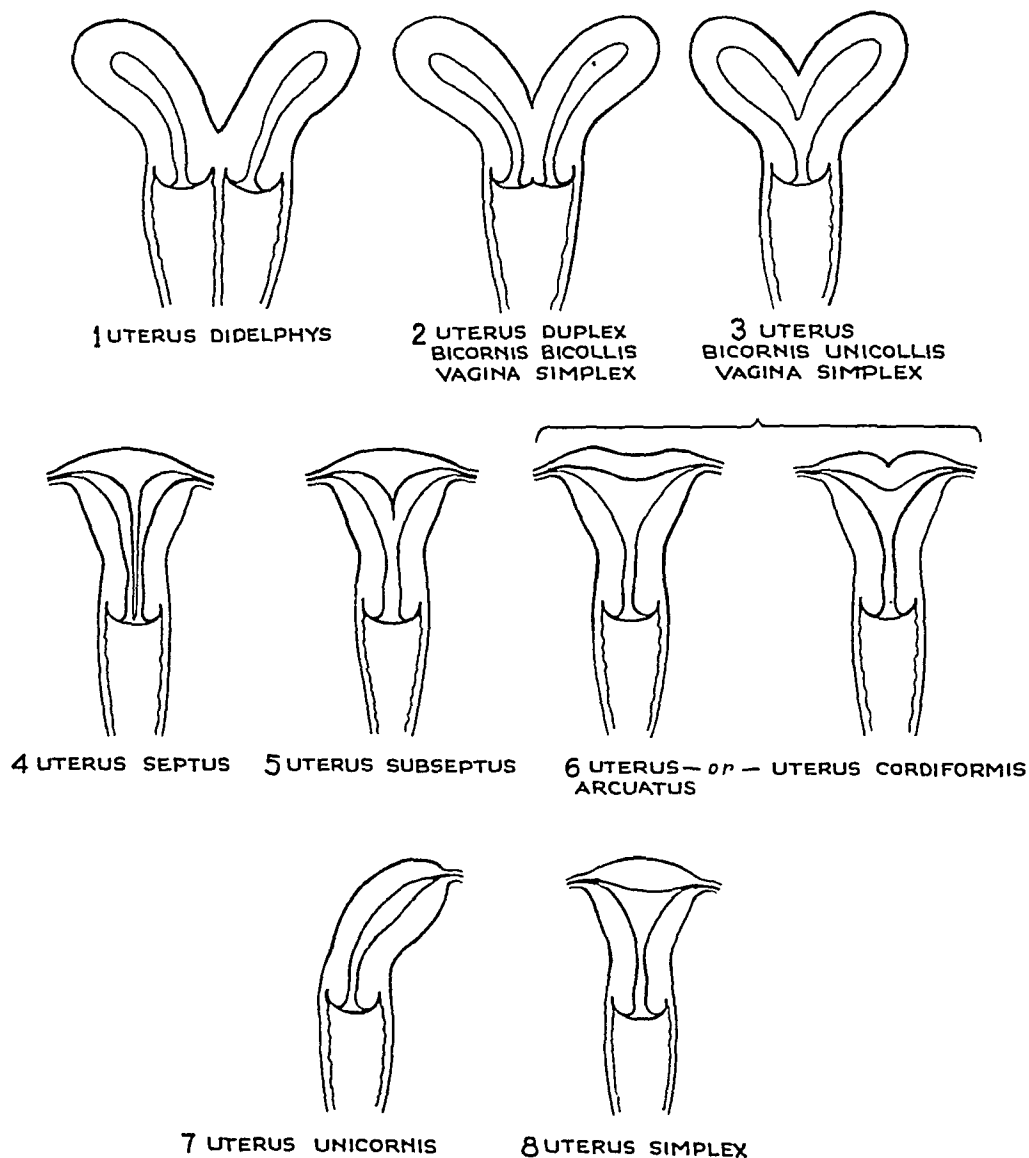
Fig. 2. Normal uterus and seven types of malformation of the uterus and vagina.

subclasses. The basic groups were: (1) Malformations due to faulty juxta-position of Müller's ducts; (2) malformations due to faulty absorption of septa; (3) malformations due to aplasia, and (4) malformations due to hypoplasia.

Today there is a marked tendency toward even further simplification. Beck in his newer text lists thirteen principal forms. In 1943, Taylor suggested further simplification and proposed a system of five basic categories. As a result of my own experience, I believe that this extreme degree of simplification is undesirable. I have found that a list of seven variations will include most cases of uterine anomaly. For this reason, I propose the use of the following types as more truly representative: (1) Uterus didelphys; (2) uterus duplex bicornis bicollis, vagina simplex; (3) uterus bicornis unicollis, vagina simplex; (4) uterus septus; (5) uterus subseptus; (6) uterus arcuatus or cordiformis, and (7) uterus unicornis.

The accompanying illustration makes detailed description of these forms unnecessary. (Fig. 2.)

Since each type listed in this schema represents a distinct stage or phase in development, it is quite simple to fit any variation of form into the proper category. For example, uterus bicornis uno latere rudimentarius (with open or closed horn) would properly belong in the third category— uterus bicornis unicollis, vagina simplex. ·

Uterus Didelphys. Uterus didelphys, in which there is duplication of the vagina, cervix and uterus, is comparatively rare. Cases of this type are usually reported in great detail when discovered. The diagnosis is sometimes an ultimate result of difficulties encountered during pregnancy or labor (Shirley and Cogswell, Galloway, Healy, Perrigard, Keevil). As Findley has remarked, the anomaly is frequently unrecognized even in the event of childbearing. Often a patient may live a long, normal life without being aware of abnormality until some other pathological condition calls attention to the malformation. This occurred in the case of a sixty-six-year old woman reported by Young. The rarity of the anomaly is well illustrated in the statistics gathered by Smith from the records of the New York Lying-In Hospital. During a twenty-five-year period there were four cases of uterus didelphys in 114,243 consecutive obstetrical patients admitted to the hospital. In the subsequent period of five years, one instance was found in 27,703 patients.

From the clinical standpoint the importance of uterus didelphys is its relation to pregnancy and labor. While fertility and pregnancy are not markedly affected, the chances of normal birth at term are greatly reduced. In fifty-four patients studied by Miller there had been a total of sixty-seven pregnancies, only twenty-eight of which (42 per cent) occurred normally and at term. Abortion and interruption of pregnancy were the chief causes for the low rate of normal birth. In the group of eleven cases reported by Schauffler (mostly uterus didelphys), there were thirty-three pregnancies, of which seventeen or 53 per cent resulted in abortion or miscarriage. These failures were attributed to the fact that intrauterine septums and irregularities of the fundus are poorly vascularized, the musculature being thin and

irregularly disposed while the stroma is inadequate. Findley attributes im-
portance to the behavior of the non-gravid uterus. Acting as an appendix
to the pregnant uterus, it may be dragged behind the gravid organ and it
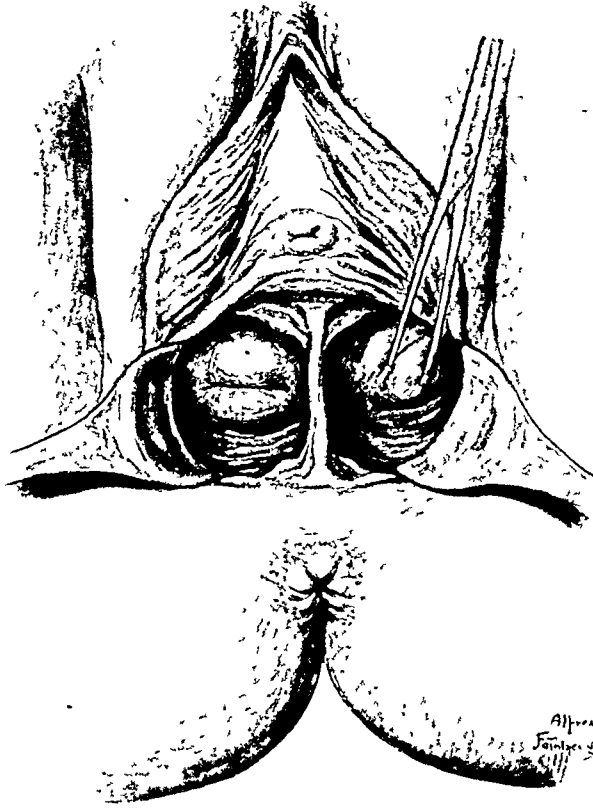
FIG. 3. CASE 1, G. M. Uterus didelphys. Note the two
cervices and septate vagina. (From Julius Jarcho, in
"Gynecological Roentgenology," 1931. By permission
of Paul B. Hoeber, Inc. Publishers.)

may retard the progress of labor by becoming incarcerated in the hollow of
the sacrum. In addition, it may contract during labor, thereby contributing
to the labor pains. Very commonly a decidual membrane is expelled on the
second or third day of the puerperium.

Findley's findings in 135 cases of uterus didelphys are relatively en-
couraging. In his series of cases, 217 full-term babies were born. There were
eighty-three spontaneous deliveries, twenty-three cesarean sections, one
craniotomy on a dead fetus, two Porro operations, one hemihysterectomy,
and one death from rupture of the uterus. Findley found that abortion is
relatively common in cases of uterus didelphys and that labor is prolonged

FIG. 4. CASE 1, G. M. Uterosalpingogram of same case (From Julius Jarcho, in "Gynecological Roentgenology," 1931. By permission of Paul B Hoeber, Inc. Publishers.)

FIG. 5 CASE 1, G. M. Vaginogram of same case (From Julius Jarcho, in "Gynecological Roentgenology," 1931. By permission of Paul B Hoeber, Inc. Publishers)

as a result of poor muscular development in the uterus, a small rigid cervix, and the encroachment of the non-gravid uterus. (Figs. 3, 4 and 5.)

Multiple Pregnancies in Uterus Didelphys. Though quite rare, twin pregnancies have occurred in women with uterus didelphys. In the case reported by Moncure, cesarean section was employed to deliver two babies, who were easily resuscitated. In the case recorded by Corbet, a live fetus was delivered spontaneously from the right uterus and three days later a second living child was born. Each uterine component behaved as an independent unit and went into labor at a different time. Thus, while the right uterus was in strong labor, the left cornu was quiescent. Of great interest is the observation of Davies and Cellan-Jones that pregnancy may occur alternately in the horns of uterus didelphys.

I have personally observed eighteen cases of congenital uterine anomaly and one case of fibroid uterus which simulated an anomaly. The pertinent data are summarized as follows:

> One patient gave birth to one living child
> One patient gave birth to three living children
> One patient gave birth to two living children and one still-
>   birth
> Two patients gave birth to two living children each (total
>   four children)
>   Total—ten living children and one stillbirth
> Three patients were pregnant once and aborted
> One patient had five pregnancies and aborted five times
> Six patients were sterile
> Three patients had no uteri
> One patient had fibroid simulating uterus bicornis
> After removal of the fibroid and a plastic operation on the
>   uterus, the patient gave birth to a living child

Confusion in Terminology. A certain amount of confusion has developed in the terminology of uterus didelphys, because some writers have used the term only for cases in which there were two separate parturient canals and bipartite vulva, an extremely rare condition. This confusion is partly attributable to the very unusual case reported by Gemmell and Paterson in 1913. In this instance there was complete duplication of the internal and external genitalia, including duplication of the bladder, uterus, vagina, and vulva. Despite this duplication there was no interference with pregnancy and labor, and living children were born from each set of genitalia. Except for the absence of an umbilicus and the presence of an "enormously" wide pelvis the patient was normal. Of interest was the fact that the intestinal viscera could be palpated between the two vulvae.

The only other case of double vulva found by Gemmell and Paterson was one reported by J. Suppiger. Recently another instance of double vulva was described by Patterson and Maxwell. Although in this case the external genitalia were double, the uterus was single and was connected to the right vagina. The small left vagina did not have an opening into the pelvis.

The paucity of examples of uterus didelphys associated with double vulva is sufficient reason for discarding the confusing term "uterus pseudo-didelphys" which has been used to denote duplication of the uterus, cervix and vagina unaccompanied by duplication of the vulva. A double vulva is not necessary for the classification. A similar opinion has been expressed by Shirley and Cogswell, and common usage does not make a distinction (Sweet). Where vulval duplication does exist, the term uterus didelphys cum vulva duplice would be more accurate.

Uterus Duplex Bicornis Bicollis. Uterus duplex bicornis bicollis vagina simplex differs from uterus didelphys chiefly in the fact that duplication of the vagina is absent. However, many of the difficulties encountered in uterus didelphys are applicable to this form as well, and in a general way it may be said that the conditions applying to uterus didelphys apply also to this anomaly.

Uterus Bicornis Unicollis. In uterus bicornis unicollis vagina simplex, or bicornate (bicornute, bicornuate) uterus, fusion is complete to a point above the cervix, incomplete absorption of the fundic segments resulting in the uterus being widely bicornate. As with other anomalies in which the uterus is double, pregnancy may occur in either or both horns. As a rule, pregnancy in one horn remains undisturbed, and the non-gravid horn produces a decidual membrane which often is expelled without disturbance of the gravid horn. Such an occurrence was reported by Wong. At six months, signs of miscarriage ended in the expulsion of a decidual cast of the non-gravid horn; three and one-half months later there was a normal delivery from the other horn.

The chief complications of pregnancy in bicornate uterus are hemorrhage and incarceration of one of the horns during labor. Braze (1943) in a review of the literature observed a lack of adequate reports of simultaneous pregnancy in the two horns of a bilateral uterus. Braze found no instance of successful termination of such pregnancy with viable children. His own report was exceptional and described a case of pregnancy in each horn which delivered spontaneously. However, this occurrence was followed in three months by prolapse and incarceration of the left horn of the uterus. The patient recovered after hysterectomy.

Special complications may arise when one of the horns is rudimentary. Perrigard cites reports which indicate that 80 per cent of rudimentary horns possess a canal which does not communicate with the vagina. It is therefore

obvious that pregnancy in a rudimentary horn may cause serious conse-
quences. Adam considers pregnancy the most dangerous complication of
double uterus because rupture of the gestation sac is almost inevitable about
mid-term if the condition remains undiagnosed. Rupture, moreover, is
associated with profuse hemorrhage. The mortality rate from this accident
is acknowledged to be high (Stander).

Not as infrequently as is generally supposed (Crossen and Crossen),
pregnancy in a rudimentary horn acts much like tubal pregnancy with all
dangers inherent in such accidents. Then too, as indicated by Frank, a
rudimentary atretic excavated horn may menstruate and eventually cause
hematometra.

Uterus Septus. Outwardly a uterus septus usually appears normal.
In some instances there may be a mild depression in the fundus. Internally,
where the inner surfaces have failed to fuse, there is a septum which divides
the cavity and which usually extends for the length of the uterus. With
other so-called milder forms of bicornate uterus such as uterus subseptus
and uterus arcuatus, the frequency of these deformities, according to Falls
(1928), is estimated to be about 1 per cent. Falls has observed that anomalies
of these types frequently give rise to complications, some of which might be
avoided completely or minimized by proper diagnosis and evaluation.

The danger of the uterus septus, as explained by Luikart, lies in the
fact that if pregnancy takes place in one half, the uterine wall of the other
half hypertrophies and by its mere bulk may obstruct delivery from the
pregnant half. Then, too, by simulating myoma, ovarian cyst, or extra-
uterine fetal sac, it may cause the obstetrician to make an erroneous diag-
nosis. If the septum extends only part of the way down, as in uterus
subseptus, the ovum may be able to utilize sufficient uterine tissue to reach
term and be born alive.

Uterus Subseptus. As a rule, uterus subseptus does not cause dystocia,
but occasionally it may cause unfavorable obstetrical conditions by produc-
ing transverse or oblique presentation of the fetus. Attempts at version
may offer the first indication of the presence of a septum. Sometimes, as
Titus has stated, the fetal trunk may become engaged around the septum.
This results in persistent transverse presentation, and cesarean section
becomes necessary.

Uterus Arcuatus (Cordiformis). In 1939, Falls in an extensive report
defined uterus arcuatus as "that form of bicornuate uterus in which the
normal fusion of the two horns in embryonic life stopped just short of
completion forming an organ which in the non-pregnant state can with
difficulty be differentiated from a normal uterus but which, when pregnant,
exhibits marked irregularities of contour." Externally, uterus arcuatus is
marked by a fundal concavity. Where the line of demarcation is deeper
and more definite, giving rise to a heart-shaped fundus, the malformation

is generally referred to as uterus cordiformis. On external examination only slight indentation (arching) of the fundus may be felt. Such uteri frequently contain a complete or incomplete septum. This can be determined only by

Fig. 6. Case ii, D. B. Roentgenogram shows fetus lying high above crest of ilium, the head in one cornu of the uterus and the legs in the other. (From Julius Jarcho, in *Am. J. Surg.*, 12: 417, 1931.)

uterosalpingography. Uterus arcuatus is one of the most common of uterine anomalies (Perrigard, Schauffler). Falls reported that of 7,553 deliveries recorded at the Research and Educational Hospital in Chicago, 155 were

associated with uterus arcuatus. Twenty-one (13 per cent) of these patients were delivered by cesarean section, while 134 patients were delivered vaginally. In the latter group labor was long and tedious, and many patients

Fig. 7. Case iii, A. S. Extirpated fibroid uterus. Large fibroid uterus with anterior wall of uterine cavity and supravaginal portion of cervix split open. One fallopian tube is seen.

failed to go into labor at term. It was necessary to induce labor in twenty-five (19 per cent) of the patients who were delivered from below.

Far from being unimportant clinically, uterus arcuatus is a malformation that requires careful consideration by the obstetrician since, as stated by Falls, the incidence of abnormalities in this group of patients is high. The complications of pregnancy were prematurity and postmaturity, while the complications of labor were prolonged first stage, breech and transverse presentation, sudden intrauterine fetal death, and retained placenta. In one of my cases of uterus arcuatus (Fig. 6, Case ii), the patient was delivered normally of two children. In her third pregnancy she experienced sudden sharp abdominal pain two weeks before term. A roentgenogram revealed that the fetus lay high above the crests of the ilium. Under deep anesthesia

external cephalic version was performed. The head was held on pelvis for nearly an hour. Pains virtually ceased. Pituitrin 0.2 cc. was given to strengthen pains and facilitate engagement. The patient was delivered spontaneously of a living child which weighed six and one-half pounds.
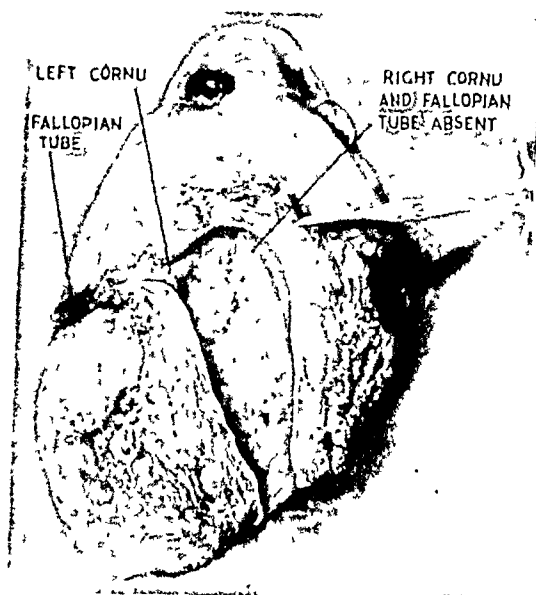
Fig. 8. Case III, A. S. Extirpated fibroid uterus. Large fibroid uterus with anterior wall of uterine cavity and supravaginal portion of cervix split open. The entire uterine cavity is exposed. The right cornu and right fallopian tube are absent. The cavity of the left cornu and left fallopian tube is seen. Diagnosis: Fibromyoma of uterus; uterus unicornis.

In another of my cases of uterus arcuatus (Case xv), the patient was delivered of a normal living child. The patient had a large pelvis. Labor was short, but fetal heart sounds became irregular and delivery was made by low forceps. (Fig. 6.)

Uterus Pseudoarcuatus. Rudolf has called attention to "pseudouterus arcuatus" (sic!), a transient deformation of the uterus caused by temporary incoordination, which leads to functional malformation. Rudolf found that some degree of incoordination of each half of the uterus is not infrequent during pregnancy and labor. A definite differentiation between "pseudo-uterus arcuatus" and the true or anatomic type of uterus arcuatus can be made only postpartum. From physiological considerations Rudolf finds that it is not necessary to fear this functional complication or to fear malposition and malpresentation. The management of such functional malformations of the uterus is intelligent expectancy.

Uterus Unicornis. True uterus unicornis, caused by unilateral sup-
pression of the Müllerian duct, is a very uncommon anomaly. In 1938,
Shumacker was able to find only twenty-eight such cases in the literature.

Fig 9 Case iv, M C Uterus unicornis, roentgenogram after injection of
iodized oil

An additional instance was reported by Schattenberg and Ziskind in 1940
and another by Varino and Beacham in 1941. According to Stander, preg-
nancy in cases of uterus unicornis tends to be uneventful and the malforma-
tion is usually recognized only accidentally during operation or at autopsy.
(Figs. 7, 8 and 9.)

COMPARATIVE ANATOMY

Students of comparative anatomy, and more recently gynecologists
and obstetricians who have delved into the subject of uterine anomalies,
recognize that a definite parallelism in structure exists between the various
types of uterine anomaly in human beings and the normal genital organs
of animals lower in the developmental scale. The importance of a wider
knowledge of this parallelism lies in the fact that such information may lead
to a clearer concept of human malformations and a better understanding
of their management.

Failure of fusion of the Müllerian ducts in women assumes one of a
definite number of forms, and as pointed out by Schumann, each of these
forms has its direct analogue in the normal form of the uterus in one or more

of the lower orders of mammals. Schumann also remarks that the lower the species in the mammalian scale the less the tendency to fusion of the two sides of the genital tract.

Indeed the similarity is often so great that Blair-Bell has suggested the use of the word "atavism" in preference to "malformation" because the anomalous uterus often conforms exactly with that of one of the lower orders. In other words, women may have uteri which are found to be counterparts of the uteri of rodents, carnivores, insectivores, or subhuman primates.

According to Wilder the uterus is an adaptive organ, essentially a localized enlargement, which develops as needed. Thus, in viviparous sharks, such as the squalus, the expanded lower portion of each Müllerian duct becomes enlarged to form a uterus in which the embryos are retained until they have almost attained adult form. The same is true of certain salamanders. However, in none of these instances is the organ more than a container or brood cavity. There is no placenta nor is there any other direct connection between the embryo and the uterine wall.

The same is true also of certain lower mammals such as monotremes and marsupials, in which there is no placenta and the young are produced in a very immature state. It is only in the higher or placental mammals that the walls of the uterus become differentiated for nutrition of the embryo, and the uterus thereby becomes a physiologically active organ.

In mammals, starting with the lower species, all the theoretical intermediate evolutionary stages have their counterpart, ranging from double uterus to single uterus. Thus, as Walter states, monotremes have two separate uteri without vaginae, whereas marsupials have two separate uteri with separate vaginae. Among placental mammals a double uterus is found in certain rodents, such as the mouse, hare, marmot and beaver, and also in elephants, certain bats and the aardvark. A beginning of fusion between the two uteri is evident in pigs, cattle, certain rodents, certain bats and carnivores. A two-horned uterus is characteristic of ungulates, cetaceans, insectivores, and some carnivores, while a single uterus, the uterus simplex, is found in apes and humans.

A more detailed consideration of each of these species will serve to illustrate further the resemblance between the normal uteri of lower animals and anomalous uteri encountered in human beings.

Monotremes. In the egg-laying mammals or monotremes (e.g., the ornithorhynchus or duckbill of Australia and Tasmania; and the echidna or spiny anteater) the Müllerian ducts tend to fuse posteriorly while the anterior portions remain separate. In the monotremes, the uterus opens into a urogenital sinus (Neal and Rand). The so-called uterine portions are in reality oviducts. As described by Wilder, they are short, thick-walled, of rather large caliber, and entirely distinct from one another.

Marsupials. The marsupials or didelphians are represented by the opossum and the kangaroo. In the marsupials a vagina occurs and this may be regarded as representing an important stage in the evolution of the

A.

B.   C.

D.
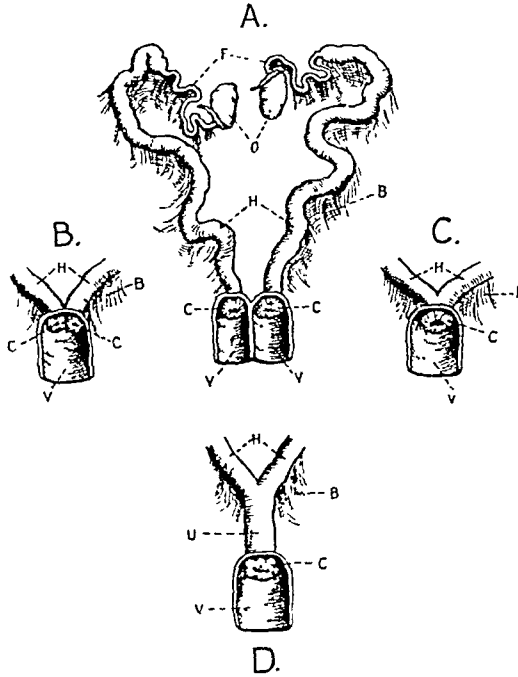
Fig. 10. Semidiagrammatic illustration to show the gradual evolution from the double uterus and vagina (A) of the lower rodents (e.g., Viscacha), and the double uterus with double os (e.g., Rabbit), or with single os (e.g., Aguti), and single vagina (B and C, respectively) to the bicornute uterus and single vagina of the carnivora (D). B, broad ligaments; C, cervix uteri; B, fallopian tubes; H, uterine cornua; O, ovaries; U, uterus; V, vagina. (From Blair-Bell in "The Principles of Gynaecology," 1934. By permission of Baillière, Tindall & Cox, London, Publishers.)

Müllerian ducts. In the opossum and kangaroo the uteri and lateral vaginae are connected with a central vaginal pouch, which has a more or less perfect longitudinal septum and ends blindly at the summit of the urogenital sinus (Blair-Bell).

Rodentia. The order rodentia (rabbits, squirrels, guinea pigs, porcupines, rats, gophers) offers examples of the transition from the primitive types of uterus to the more advanced forms (Owen). Two distinct uteri,

with separate cervices, are found in the lower species, such as the viscacha and rabbit. In the agouti the uterus is double but has a single cervix. In rodents the vagina, from being septate or double in lower forms becomes

INTERNAL
CIRCULAR
MUSCLE COAT

MUCOSA
EXTERNAL
LONGITUDINAL
MUSCLE COAT
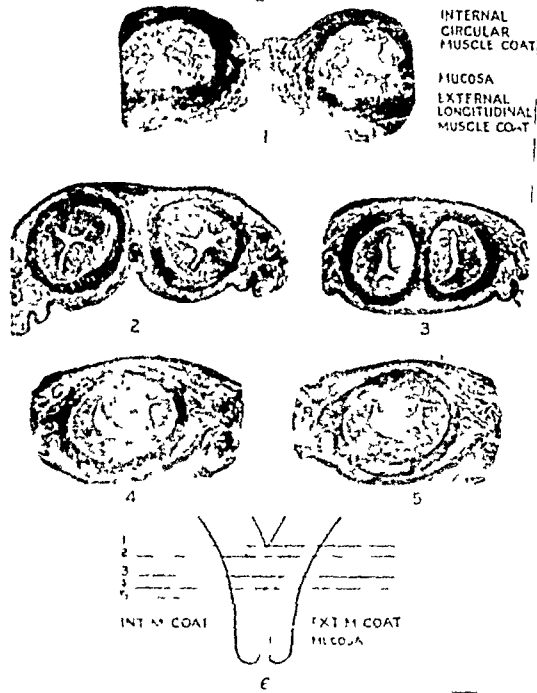
Fig. 11. A selection from serial sections of the uterus of the cat (1, 2, 3, 4, 5), showing the fusion of the two horns from where they first come together to below the point of complete fusion. The lines of section are made clear by the diagram (6). The way in which first the external coats, and then the internal coats, and finally the mucosae come together and fuse is clearly demonstrated. Fusion in the rabbit stops at stage 3, consequently that animal has two cervices surrounded by two circular muscle-coats and one external muscle-coat; (microphotographs × 5). (From Blair-Bell in "The Principles of Gynaecology," 1934. By permission of Baillière, Tindall & Cox, London, Publishers.)

single in the higher members of the order. In pigmy musks Owen states that "the cornua of the uterus are unequal in size: the right was the largest in the specimen examined." (See Fig. 36, Case XII.) (Fig. 10.)

Carnivora. The next important step in development is found in the order carnivora (cats, dogs, weasels, bears, raccoons, seals) where the two

uterine bodies fuse in their lower parts to form a bicornate uterus. (Figs. 11 and 12, A, B and C.)

Ungulata. The order ungulata (hoofed animals) also offers examples
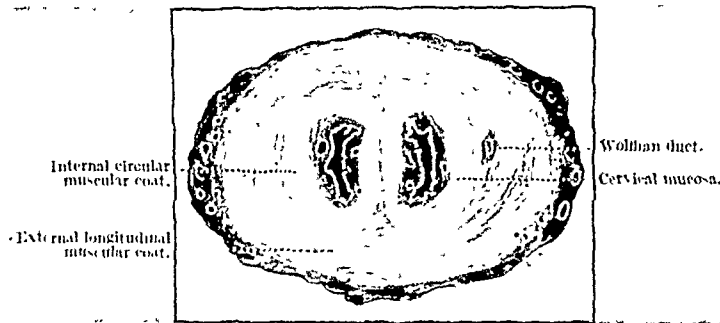
FIG. 12. Section through a double cervix (after Kelly). In the original description no mention was made of the beautiful way in which the muscular coats are demonstrated: the arrangement is identical with that seen in the rabbit. (From Blair-Bell in "The Principles of Gynaecology," 1934. By permission of Baillière, Tindall & Cox, London, Publishers.)

of the uterus bicornis. According to Patten, in the sow the fusion of the Müllerian ducts is carried only a short distance beyond the cervix to form a typical bicornate uterus. In his text on developmental anatomy, Arey cites the uterus of sheep as a typical example of bicornate uterus.

Primates. The uterus simplex, the highest form of uterine development, is found in the primates, which includes monkeys, baboons, apes and man. According to Neal and Rand (1939), a sub-order of primates, the lemuroids (including lemurs and tarsiers), have two-horned uteri (uterus bicornis). However, some of the lemuroids have arcuate or cordiform uteri.

Although, as noted by Perrigard, the uterus unicornis is normal in birds, Blair-Bell believes that this anomaly cannot be considered an atavism, but rather the result of the total suppression of one Müllerian duct.

Congenital Absence of Uterus. Although small or infantile uteri are quite common, complete congenital absence of the uterus is quite rare and it is very improbable that in the few cases reported there was absolute absence of all vestiges of the organ. Nevertheless, this seems to have occurred in the case of apparent congenital absence of uterus reported by Bowles and Burgess. Following the removal of an appendix in an eleven-year-old Korean girl, it was noted that the broad ligament of one side swept across the region where the uterus should have been and fused with its counterpart from the opposite side of the pelvis. No thickening was found that could be interpreted as the uterine body. The ovaries were normal, but vaginal examination revealed no apparent cervix.

TABLE I

NON-PLACENTAL MAMMALS

Monotremes—Egg-laying mammals
(two separate uteri without vaginae)

Echidna or Spiny Anteater Ornithorhynchus or Duckbill		

Marsupials—Didelphians
(two separate uteri with separate vaginae)

Kangaroo Opossum		

Placental Mammals
(double uterus)

Aardvark Certain Bats Beaver	Elephant Hare Marmot	Mouse

Rodents
(with more advanced form of uterus)

Gopher Guinea Pig Porcupine	Rabbit Squirrel Rat	

Carnivores
(uterus bicornis)

Bear Cat Dog	Raccoon Seal Weasel	

Ungulates—Hoofed Animals

Sheep	Sow	

Primitive Primates—Half-apes

Lemur* (Lemuroids) Tarsier		

Primates
(uterus simplex)

Ape	Man	

* Some members of the lemur family have more advanced uteri (arcuate or cordiform).

Congenital Absence of the Vagina. As noted by Blair-Bell, a rudimentary uterus which is imperforate and consists mainly of fibrous tissue, is associated with absence of the vagina. Wharton attributes absence of the

Fig. A. Australian echidna or spiny anteater (an egg-laying mammal). (By permission of the American Museum of Natural History, New York.)

vagina to inhibition of the development of the Müllerian ducts. In this condition the growth of the ducts ceases very early in embryonic life. The ducts remain separate and do not fuse to form the uterus, cervix or upper vagina. Anderson (1931), however, takes a view opposite to that given by most writers. He is of the opinion that absence of the vagina and uterus is usually caused not by lack of fusion of the Müllerian ducts but by premature fusion.

For obvious reasons, abnormalities of the vagina are more frequently observed and reported than are internal malformations of the genital tract. Hence malformations of the vagina, such as atresia or complete or partial vaginal septum, are not considered rare. However, Reel, in a report of four cases of congenital absence of the vagina encountered during a twenty-three-year period, considers total absence of the vagina as probably the rarest congenital maldevelopment of the female genital tract. Various mechanical procedures and a variety of surgical technics have been developed to correct some of these abnormalities or to restore a degree of normalcy to others. A concise comprehensive review of the major surgical procedures for forming an artificial vagina was recently presented by Marshall.

Grave anomalies of the uterus are often accompanied by other serious errors of development, including not only vaginal atresia, but also such conditions as cloacal defects, atresia ani, vulvovaginal anus, malformations

Fig. B. Female kangaroo and its marsupium; note head of young in pouch. (By permission of the American Museum of Natural History, New York.)

of the abdominal wall, hernia, and other defects (Wharton). Occasional reports, such as those of Benjamin and Danforth and Siegel, describe bizarre combinations of developmental abnormalities associated with uterine anomalies. In Siegel's recent paper, the congenital anomalies noted in a twenty-one-day old infant consisted of: absence of right kidney and ureter, uterus didelphys, imperforate anus, imperforate vagina, pseudohydrocolpos, urethrosigmoid, (pseudohermaphrodismus femininus externus). Such a conglomeration of congenital anomalies is obviously incompatible with life.

Milder combinations of malformation also appear. For example, Ladd and Chisholm recently reported a case in which a double uterus and vagina was associated with duplication of the sigmoid and rectum with two external openings.

Uterine Anomalies Associated with Anomalies of the Urinary Organs. Since the embryonal predecessor of the Müllerian duct also contributes to the development of the urinary tract (Reel), it is not surprising that uterine

FIG. C. Varied lemur (*Lemur variegatus*, Kerr). (By permission of the American Museum of Natural History, New York.)

anomalies should often be associated with renal agenesis. Indeed, many authors have called attention to the frequent coincidence of congenital anomalies of the genitalia and anomalies of the urinary tract. Hinman, in a

Fig. 13. Case v, J. F. Uterus bicornis unicollis. Both halves of the uterus are split open and are shown to be connected by nothing more than the supravaginal portion of the cervix.

critical review of congenital bilateral absence of the kidneys, states that renal agenesia is usually associated with gross malformation of other organs. In the female, the derivatives of the Müllerian ducts are most often affected.

Unilateral renal agenesis is frequently associated with uterus unicollis, but it occurs in association with symmetrical uterine anomalies as well as with unilateral defects. One of my own cases (Case v) showed uterus bicornis unicollis associated with absence of the right kidney. (Figs. 13 and 14.)

A study of the literature shows that in many cases of uterine or other genital malformation there has been no attempt at adequate urological examination. Conversely, in cases of abnormalities of the urinary tract there is very often a lack of thorough investigation of the genital system. It should be regarded as axiomatic that in all cases in which the genital tract is anomalous the urinary tract must be studied thoroughly.

INCIDENCE

Individual reports covering one or more cases usually advance our knowledge of uterine malformations but do not give a true index of the frequency of these anomalies. Even compilations from the literature fall short of the mark in giving a true picture of the incidence. Thus, in a review of the literature from 1922 to July 1936, Beaver and Abbott found reports of 246 cases of malformations of the uterus. They readily admit, however, that because of the voluminous literature, other cases may have been overlooked.
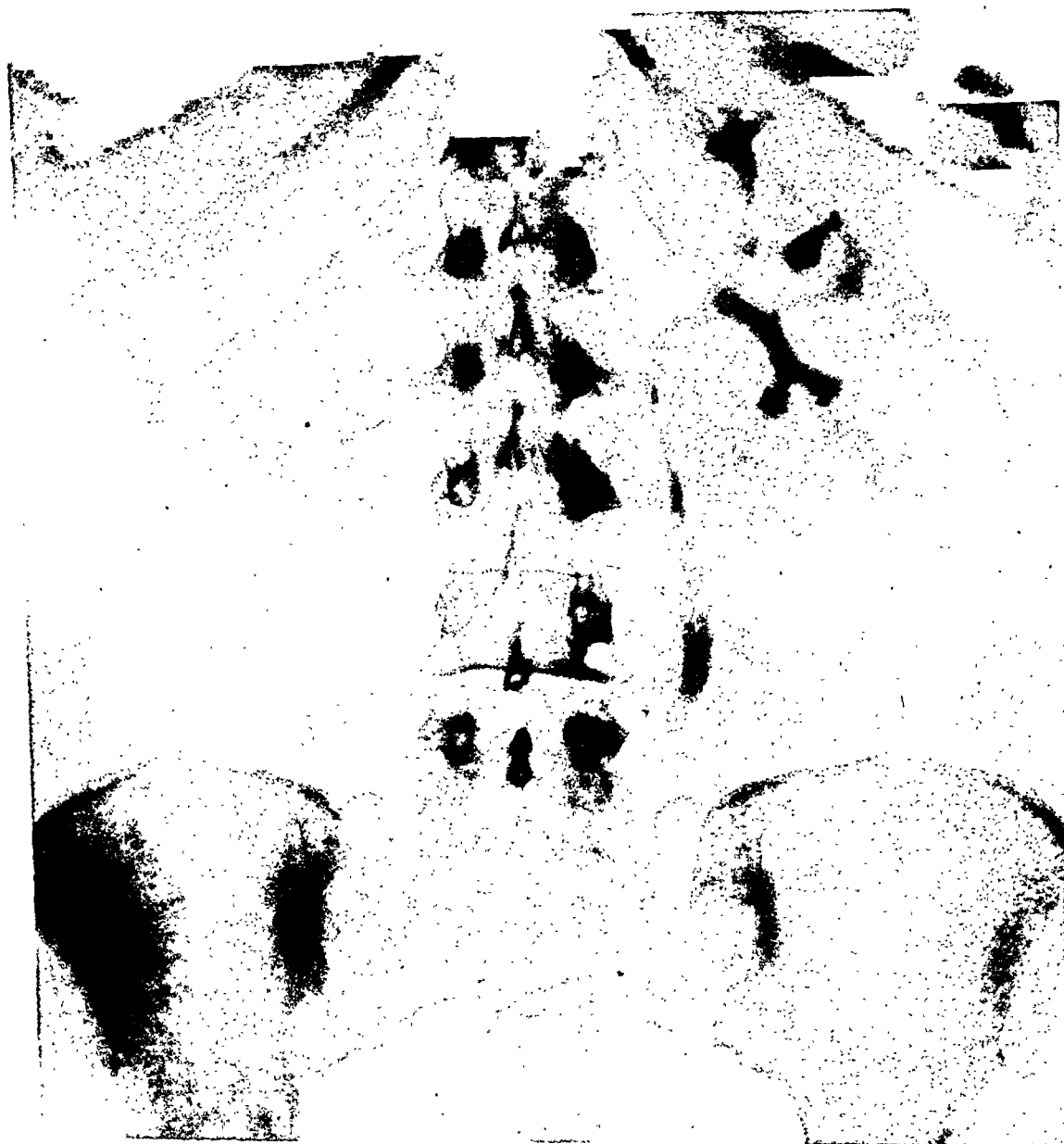
Fig. 14. Case v, J. F. Pyelo-ureterogram after retrograde injection of hippuran solution into the left ureter. The right kidney was absent.

In addition, many cases are discovered but remain unreported or are not reported in adequate detail. This fact becomes quite evident to anyone who reads the published discussions that follow the presentation of almost any paper on uterine anomalies. Often such anomalies are given but casual mention. Moreover, as Findley has remarked, one is impressed by the frequency with which anomalies remain unrecognized even in the event of parturition. Many malformations are first discovered at laparotomy or at autopsy.

Considering the fact that many cases of uterine malformation are observed only at autopsy or accidentally during operation, and that other cases are discovered only in the event of an abnormal occurrence during pregnancy and labor, it is evident that a large number of cases must remain unsuspected and undiscovered. Probably the closest approach to the true incidence of uterine anomalies is to be found in carefully kept hospital records covering a period of years. Here, too, the aforementioned factors, as well as the efficiency of the medical staff, must be taken into consideration. One of the most significant reports of this type was published by Smith on the basis of statistics gathered at the New York Lying-In Hospital during a period of thirty and one-half years (January 1899 to July 1930). During this period thirty-five cases of double uterus were recorded; nineteen of these were observed by Smith personally. Smith was astonished to note that all types of double uterus had occurred once in 1,458 cases during the five and one-half years of personal observation, whereas in the records of 114,243 consecutive patients examined during the previous twenty-five years double uterus had been recorded once in 7,040 cases. It was inferred that some cases were not recognized or had not been recorded. It is more probable that better understanding of uterine anomalies and improved diagnosis may account for the apparent increase in incidence. Smith observed that foreign-born patients show a greater tendency to uterine anomaly than do women of so-called native American lineage.

Other hospital data since reported give valuable information. In Germany, Pfleiderer reported that during a period of twenty years ninety-three instances of genital anomaly were observed at the Tübingen Frauenklinik. There were fourteen instances of rudimentary solid uterus with solid vagina, six of uterus unicornis with rudimentary horn (more accurately classified as uterus bicornis uno latere rudimentarius), fifteen of uterus bicornis bicollis with double or single vagina, fifteen of uterus bicornis unicollis, sixteen of uterus septus with double or single vagina, and twenty-seven of uterus arcuatus.

This may be contrasted with the series of seventeen cases studied at necropsy by Masson and Kaump. These authors found three cases of uterus didelphys, four of uterus duplex and septate vagina, three of uterus rudimentarius solidus duplex with absence of vagina, two of absence of one

fallopian tube and ovary, and one case each of uterus unicornis, abnormal insertion of the fallopian tubes, hemihypoplasia of uterus, rudimentary uterus with atresia of the vagina, and atresia of a fallopian tube.

Citing statistics gathered from the registers of the Gynecological Institute of the Kyoto Imperial Institute, Kimura reported the frequency of uterus bicornis as 0.141 per cent. In other words, fifty-two out of 36,785 . out-patients showed this type of anomaly during a five-year period preceding 1930. Cases of uterus arcuatus were not considered.

In their report on pregnancy in uterus duplex, Acosta-Sison and Katigbak stated that of the 68,682 maternity cases admitted to the Philippine General Hospital from 1912 to 1937, only three cases of bicornate uterus were noted. Falls' statistics (1939) with regard to the incidence of uterus arcuatus have already been cited.

That uterine anomalies are not as infrequent as might be imagined is evident in an estimate cited by recent writers (Taylor, Eisaman). It is stated that lack of fusion of the Müllerian ducts, either complete or incomplete, occurs once in about 15,000 obstetric, and about once in 2,000 gynecologic cases. From this estimate it is evident that even a specialist may see few cases in a lifetime of medical practice.

Other writers believe that the incidence of anomalies is much higher than such statistics indicate. Moore, for example, is of the opinion that the incidence of congenital anomalies in the female genitalia is probably much higher than the imperfect and random records would indicate. From private records, Moore arrives at the conclusion that one in five or six hundred women present some definite congenital deviation from the normal in the generative tract.

SYMPTOMS ASSOCIATED WITH GENITAL ANOMALIES

As has already been indicated, many women with malformation of the uterus may go through their span of life without any signs attributable to their abnormality. Thus, the symptoms of double uterus may be negligible. Conversely, deformities sometimes take on great importance and become of major moment not only with respect to their sex lives, but also, on occasion, with respect to their very existence.

Prior to pregnancy, the symptoms caused by double uterus may be slight, but menstrual disorders are encountered quite frequently and occasionally there may be difficulty in coitus. Menstrual discharges usually come from both uteri simultaneously, but may also come from one uterus at a time. According to Bainbridge, with uterus duplex, menstruation may take place every two weeks, first from one compartment of the organ, then from the other, each menstruation lasting two or three days. The patient loses in one month only about as much blood as during a normal menstrual period.

Dysmenorrhea, often quite severe, is a complaint commonly associated with bifid uterus. According to Miller, dysmenorrhea occurs in about 20.3 per cent of the cases and is an important diagnostic aid. Menorrhagia is
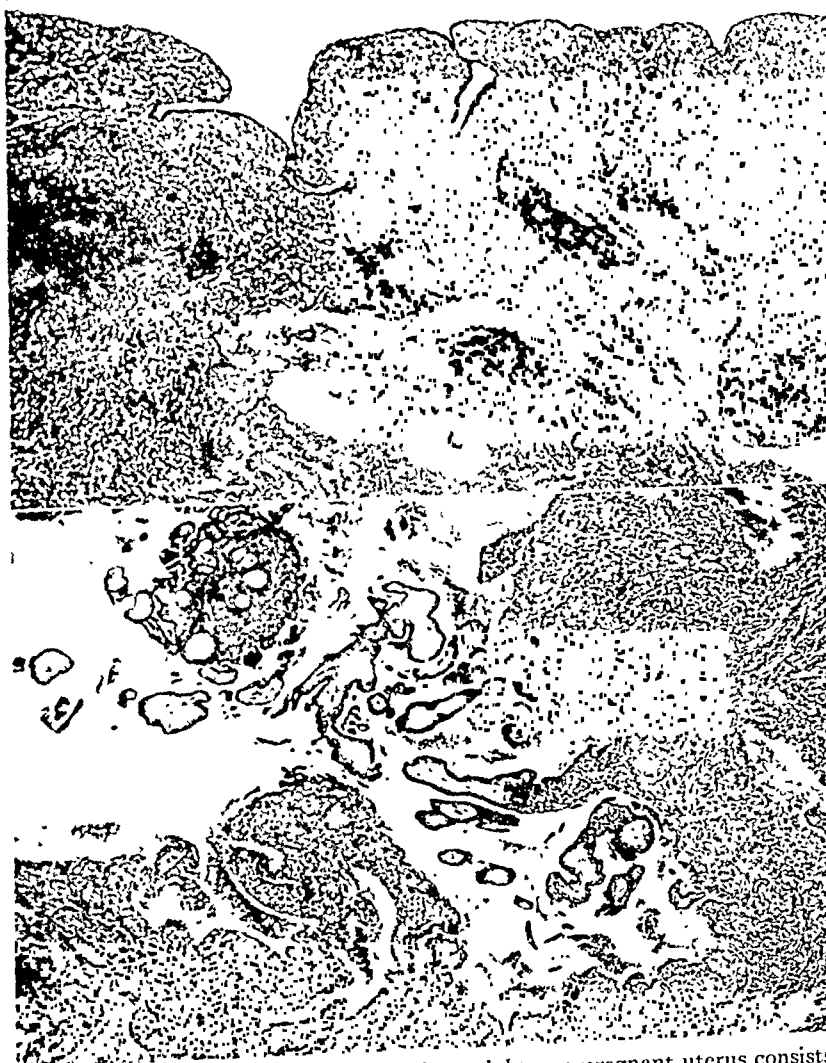
FIG. 15.

FIG. 16

FIG. 15. CASE VI, S. C. Cast expelled from right non-pregnant uterus consists of decidual tissue only.

FIG. 16. CASE VI, S. C. Tissue obtained by curettage of left-sided uterus consists of chorionic villi. (Compare with Figure 15.)

often severe and frequently makes operative interference necessary (Snyder). In any instance of uterine anomaly in which the area of the endometrium is increased, whether as the result of bicornate uterus or septate uterus, there is a definite tendency to menorrhagia (Masson and Rieniets).

During pregnancy in one horn of a bicornate uterus, the non-gravid horn usually forms a decidua. In one of my cases, the patient expelled a decidual cast from the non-pregnant uterus and five days later expelled the
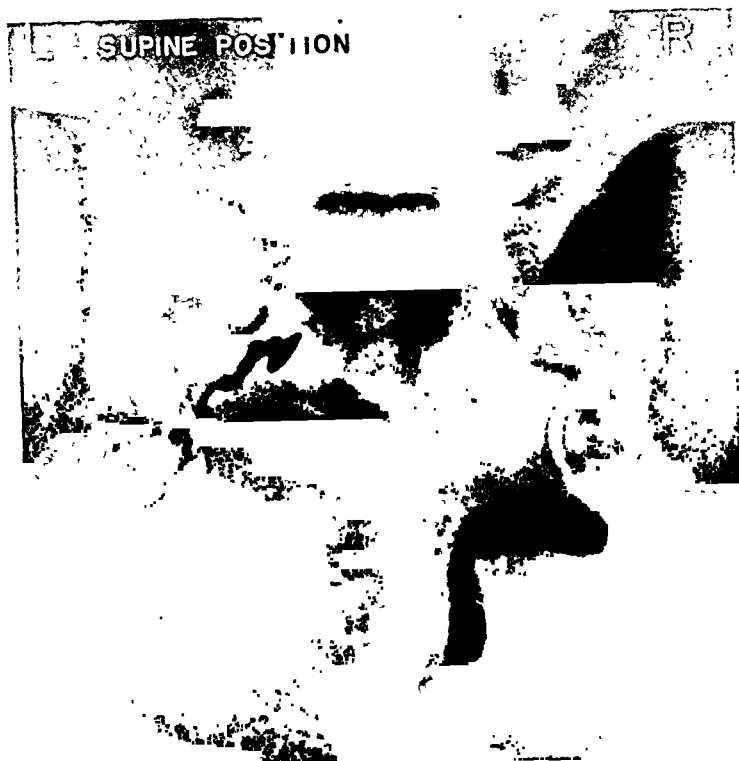
FIG. 17. CASE VI, S. C. Uterus duplex bicornis bicollis, vagina septa: occlusion of right fallopian tube. Uterosalpingogram, combined method, 800 cc. of carbon dioxide, followed by 5 cc. of opaque medium in the right uterus and 7 cc. in the left uterus. The right uterus is well outlined. It is filled with opaque medium except for the region of the right cornu which is occupied by a small quantity of trapped gas (reader's right). Right tube is occluded and did not permit trapped gas to leave uterine cavity. Left uterus well out-lined and filled throughout its entire extent with opaque medium. Left cornual sphincter evident. Left tube curled on itself was occluded but became patent after introduction of gas under pres-sure of 190 mm. Opaque medium is seen exuding from left ostium abdominale.

entire ovum from the pregnant uterus. Sometimes the non-pregnant horn may continue to menstruate (Bainbridge). (Figs. 15, 16, 17 and 18.) Findley suggests that this fact indicates the independence of the functions of the two horns. Schauffler believes that the decidua in the non-pregnant horn is subject to the same hormonal influences which control the actual preg-nancy. Hence the non-gravid uterus may be expected not to bleed normally

at any time during the pregnancy. Thus, when irregular bleeding does occur, this writer believes that it should be considered in connection with damage to the chorionic tissue of the pregnancy itself and should be treated by

FIG. 18. CASE VI, S. C. Schematic drawing of Figure 17.

procedures indicated in threatened abortion. Bleeding occurred three times in fifteen successful pregnancies in Schauffler's series of patients, and it occurred in all those who miscarried.

Taylor states that in a patient with duplication of the uterus bleeding during gestation may be due to the passage of a decidual cast and need not necessarily be indicative of threatened abortion.

Occasionally the decidual membrane may be expelled before parturition occurs from the gravid uterus, thereby simulating abortion. Meanwhile pregnancy continues undisturbed in the other horn. Unless the presence of double uterus is recognized, the surgeon may curette away the living ovum in the belief that an abortion has occurred (DeLee and Greenhill). Spontaneous abortions are not infrequent in such cases and in septic abortions both uteri should be emptied (Shirley and Cogswell).

DOUBLE UTERUS AND CONCEPTION

Fertility and frequency of conception in the presence of double uterus are not greatly affected (Masson and Kaump, Campbell, Meaker). On the
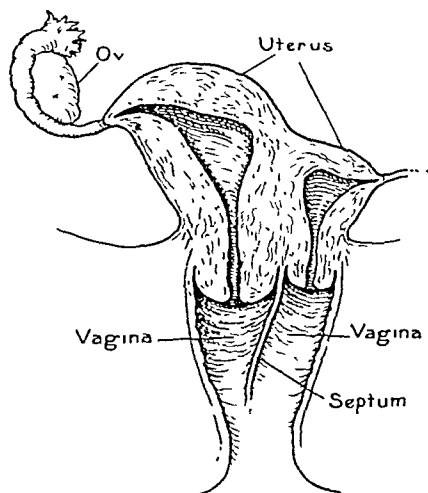
FIG. 19. CASE VII, M. G. Schematic drawing of uterus duplex, bicornis, bicollis, vagina septa. The right uterus is the larger. The septum is directed from left to right, narrowing the right ostium of the vagina.

contrary, double uterus seems to favor conception (Luikart). "In fact," says Schauffler, "one is almost tempted to infer that fertility and the sex urge are distributed among these women in the same generous ratio as their organic sex equipment."

SUPERFETATION

In women with double uterus, the proportion of twins is definitely greater than in normal women. Berkeley, Bonney and MacLeod point out that with a normal single uterus, the ratio of twins is 1 in 89, whereas with double uterus it is 1 in 12. Naturally, this brings up the question of superfetation. Students of the subject, like Findley and Blair-Bell, believe that duplication of the uterus presents frequent examples of what may properly be regarded as superfetation.

Nevertheless, one must not overlook the fact that some anomalies of the uterus are associated with sterility and it is known that some patients with double uterus may have difficulty in becoming pregnant. Sterility, however, may be due to a mechanical obstacle to conception. (Fig. 19.)

Kelly and his collaborators, when grouping the factors responsible for sterility, stated that 11 per cent of cases of sterility are attributable to developmental anomalies of the vagina, uterus, tubes or ovaries (including infantile pelvic organs).
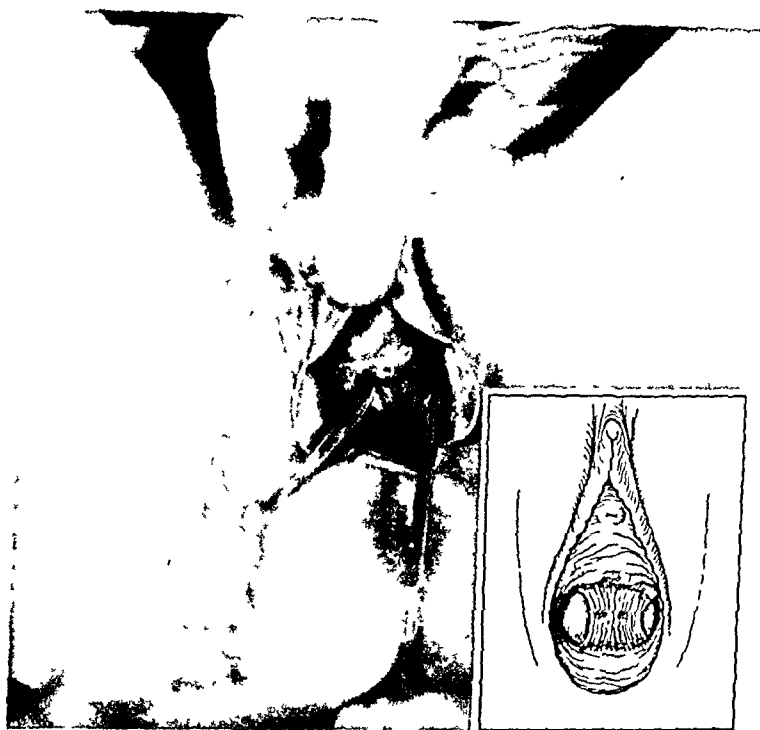
FIG. 20. CASE VIII, E. B. A photograph of the wide thick septum of the vagina. A Mathieu speculum has been introduced into the vagina. The lateral edges of the septum have been pushed to the midline to expose the lateral walls of the cervix. Tenaculum forceps have been applied on each side of the cervix. Diagnosis: Uterus unicornis; uterus biforis; vagina septa. *Insert:* Schematic drawing of the wide thick septum of the vagina covering the cervix. After excision of the septum a septate cervical canal was seen (uterus biforis).

MANAGEMENT OF PREGNANCY AND LABOR IN DOUBLE UTERUS

The statement is frequently made that the management of pregnancy and labor in cases of double uterus should not differ from the management of normal cases, except in the event of complications. Taylor, on the contrary, believes that the condition is itself a complication of pregnancy and *should so be regarded.* Unfortunately, a large proportion of uterine malformations do not become manifest until complications occur or until a history of previous interrupted pregnancies leads to thorough investigation. Then, too, as Rosenbloom reminds us, the literature contains many reports

of full term pregnancies in double uteri and frequently these pregnancies have terminated spontaneously with the birth of living babies.

In my experience, operative interference was required in two cases.

FIG. 21. CASE VIII, E. B. Uterosalpingogram shows well developed uterus unicornis and patent left fallopian tube. Note wide dissemination of opaque medium in peritoneal cavity. Aplasia of right cornu and right fallopian tube.

Each was delivered by cesarean section twice (healthy children obtained); one had five incomplete abortions which required curettage once.

It is well established through careful studies such as those of Smith that in women with congenital uterine malformations there is a higher proportion of fetal and infant deaths, a lower percentage of viable babies and an increased tendency toward fetal abnormalities. (Figs. 20 to 24.) Puddicombe also notes that deformities of the fetus, such as scoliosis, talipes equinus and polydactylism are not infrequent. Similarly, in his contribution to the pathology of arcuate and bicornate uterus, Ernst finds that in addition to unfavorable position, poor contraction and early separation of the placenta, unusual conditions affecting the fetus are relatively common. These include amputations and developmental defects. All possible malformations of the placenta also occur and are attributable to faulty implantation. Ernst notes that hyperemesis and preeclampsia are common.

UTERINE ANOMALIES AND ABORTION

Patients with malformation of the uterus show a markedly increased tendency to abortion (DeLee and Greenhill, Falls (1933), Smith). In his

series of 135 cases, Findley reported the incidence of abortion as 39.6 per cent. In Schauffler's series of eleven cases of double uterus with pregnancy there were thirty-two pregnancies of which seventeen aborted or miscarried,

FIG. 22. CASE VIII, E. B. Vaginogram shows that the opaque medium has distributed itself around the septum. The upper portion of the vagina is wide. Filling defect seen in the lower portion of the vagina is produced by the septum. Salpingogram of left tube is shown. Salpingogram shows that the right fallopian tube is absent. Diagnosis: Uterus unicornis; uterus biforis; vagina septa.

a proportion of 53 per cent. Taylor estimates that the incidence of abortion in cases of uterine anomaly is about 25 per cent. However, he concedes that since some instances of abortion may be due to unrecognized anomaly, the higher figures may be more accurate.

A policy of watchful waiting is usually advocated in patients with uterine malformation. This should not preclude the utilization of any and

FIG. 23. CASE VIII, E. B. Roentgenogram of pelvis showing fetus of 234 days' gestation.

FIG. 24. CASE VIII, E. B. Uterosalpingo-gram after peruterine injection of opaque medium of dead fetus of Case VIII showing cordiform uterine cavity. Both fallopian tubes are well outlined.

all immediate and positive measures that will bring the pregnancy to a successful termination.

The frequency with which pregnancy in the rudimentary horn of a double uterus is mentioned in the literature is a definite indication of the danger of this occurrence. When the canal of a rudimentary horn communicates with the vagina, fertilization of the ovum may occur by the natural route. Very often, however, the rudimentary horn has no connection with the uterine cavity and pregnancy in the horn is effected by external migration of the spermatozoon or a similar migration of a fertilized ovum from the normal side (Kelly). In either case the abnormal structure of the rudimentary horn constitutes a most serious complication. As remarked by Cherry, the musculature of the maldeveloped portion usually does not react as does the fully developed uterus; it is unable to stand the strain of the growing fetus. The result is a condition similar to tubal pregnancy. Ectopic pregnancy, with subsequent rupture and hemorrhage, was reported over forty times in the 246 cases of uterine malformation reviewed by Beaver and Abbott.

According to Falls (1933), the degree of fetal development attainable before rupture of the rudimentary horn will depend on the capacity of the horn to hypertrophy and dilate to meet the needs of the growing embryo. Rupture in a rudimentary horn is prone to occur somewhat later than in tubal ectopic pregnancy and because of this fact the associated concealed hemorrhage may be all the more severe. When rupture does occur, it usually produces shock and anemia. This author is of the opinion that the whole clinical aspect simulates the interstitial type of ectopic pregnancy rather than the tubal or ovarian type.

It is not always easy to diagnose pregnancy in a rudimentary uterine horn. Palpation will sometimes show the more normal horn at one side to be of usual or slightly softened consistency. Occasionally signs associated with bicornate uterus, such as double septate vagina or double cervix will provide a clue that uterine malformation is present and so help to differentiate the condition from other forms of ectopic pregnancy. However, as Kerr · has so aptly observed, it is often of no very great practical importance which condition is diagnosed, except for the satisfaction of a correct and exact diagnosis, because surgical treatment should be undertaken immediately.

The great danger, as Kerr emphasizes, lies in mistaking a gravid rudimentary horn for a myoma complicating normal uterine pregnancy. In the event of such an error, if pregnancy is permitted to continue in the hope that the myoma may be pulled up out of the pelvis (as often occurs), the patient's life may be endangered by rupture of the gravid horn.

It is generally accepted that the treatment for pregnancy in a rudimentary horn, once diagnosed, is immediate laparotomy and prompt removal of the gravid uterus (Acosta-Sison and Katigbak, Beck, Blair-Bell,

Falls (1933), Kelly). Stander has observed that the mortality statistics for this condition have become much more favorable because of greater accuracy of diagnosis and more frequent recourse to surgical intervention.

In cases with double uterus it is not unusual for pregnancy to go to term, and delivery often occurs without marked difficulty, but the proportion of patients with uterine malformations who go to term is considerably less than in the case of women with normal uteri. The frequency with which normal delivery occurs will depend to a large extent upon the severity of the malformation. For example, only a small proportion of pregnancies in uterus didelphys go to term (Moncure). In Miller's series, only 42 per cent of such cases (occurring in twenty-eight of the total sixty-seven pregnancies) had a normal spontaneous delivery at term. Abortion or interruption of pregnancy before the period of viability were the chief causes for this low percentage.

UTERINE ANOMALIES AND COMPLICATIONS IN PREGNANCY

A high ratio of difficult or complicated labor is to be expected in women with uterine malformations. Labor is often normal, but as is pointed out by DeLee and Greenhill, complications such as the following have been observed: weak pains; atony in the third stage with postpartum hemorrhage; adherent placenta; prolapse and incarceration of the non-pregnant portion of the uterus under the pregnant portion. The cervix of the non-pregnant uterus may be forced down to the vulva with the head. The uterus may rupture because of poor musculature. The septum in the vagina may form an obstruction.

In his report on uterus didelphys, Miller pointed out that 40 per cent of women with this anomaly have complicated deliveries at term. He listed the complicating factors in the following order: enlarged non-gravid uterus; vaginal septum; uterine inertia; tetanically contracted uterus; retention complications, and eclampsia. Retention complications were found in 17 per cent of all cases.

Other factors may complicate the picture. Irregularity of the fetal heart is not uncommon, not only during labor (Falls 1928), but also in the later months of pregnancy (Puddicombe). Manual removal of the placenta is often necessary, and even in the event of spontaneous delivery the placenta often fails to separate (Smith). Postpartum hemorrhage is likewise a frequent complication and its management is often difficult. Less serious complications of labor are very frequent (Rhemann).

In discussing pregnancy and the double uterus, Taylor warned that when these patients come to labor it is well to remember that the cervix may be poorly formed and that the musculature of the uterus may be irregular, poorly vascularized, thin, and irregularly disposed, while the stroma may be inadequate.

The septate uterus, according to DeLee and Greenhill, may cause breech and transverse positions, weak pains, postpartum atony, rigidity of the cervix, adherent placenta, and, if the septum is in the cervix (uterus biforis), obstruction to delivery.
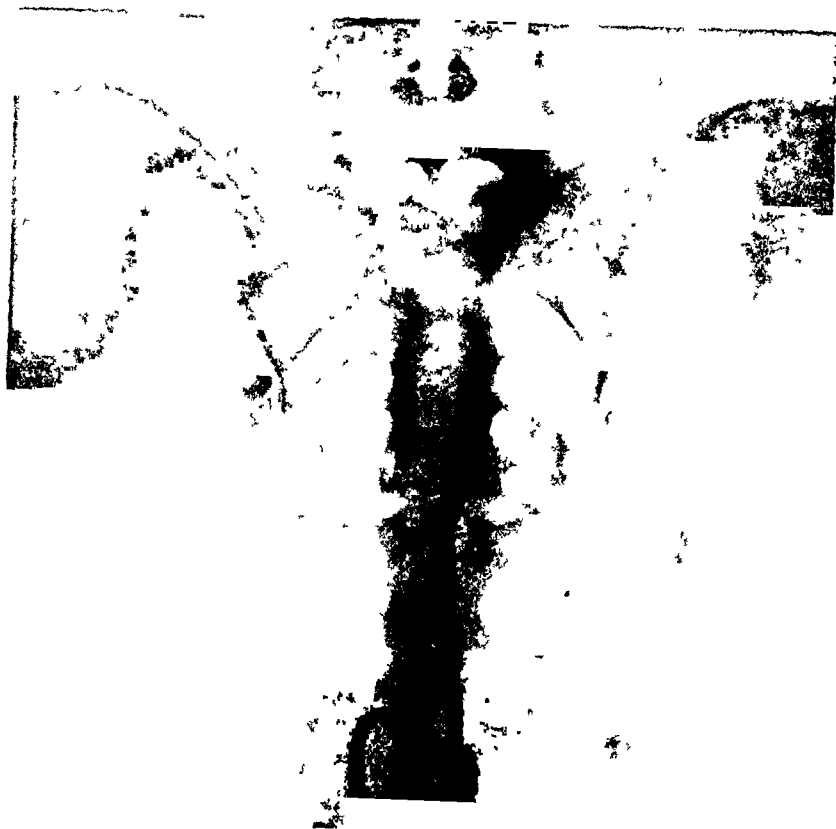
Fig. 25. Case ix, A. S. Roentgenogram of uterus duplex, bicollis Vagina septa with defect in the septum between the uteri. A sound introduced into each cervix crossed through the defect in the septum and entered the opposite uterus.

As Falls has stated (1939), the course of labor in patients with the more common anomaly, uterus arcuatus, differs markedly in individual cases. Thus, in a small proportion of cases labor takes onset from a few weeks to two or three months in advance of the normal time, while in a somewhat larger group there is a definite tendency to postmaturity, varying from a few days to a week or more. In many cases this postmaturity may be due to failure of the presenting part to engage normally at term and this in turn is attributable to obliquely transverse presentation of the fetus and to deficiency in the development of the uterine muscle. Induction of labor is often necessary and the response may be weak and unsatisfactory. When

labor starts spontaneously, the pains are often weak and irregular and a slow course of labor may be expected.

In a series of patients with uterus arcuatus studied by Falls, the

FIG. 26. CASE IX, A. S. Roentgenogram of uterus duplex, bicollis. Vagina septa with defect in septum. The cannulas crossed in the defect in the septum. There was an intravasation of the uterine blood vessels. Opaque medium has entered the uterine blood vessels, presumably because the septum was thin and the vessels were distended.

incidence of postpartum hemorrhage was twice that observed in ordinary cases. A maternal mortality of 1.9 per cent clearly indicates that the condition should be regarded seriously as a complication of pregnancy and labor.

In the management of pregnancy complicated by double uterus, it should be remembered that the relatively thin uterine wall presents a constant threat of rupture if labor is long or even if it is brief and difficult (Gramling). According to Puddicombe, if rupture does occur, it generally takes place during the last month of pregnancy or during labor. In his

opinion, the uneven distribution of uterine muscle and misdirected forces serve to protract labor and weaken the uterine wall, thereby increasing the danger of rupture. More rarely, the non-gravid horn may obstruct the

FIG. 27. CASE IX, A. S. Vaginogram of septate vagina. Note opaque medium remaining in the peritoneal cavity from previous uterosalpingogram. (See Figure 26.)

passage of the child, causing rupture of the pregnant horn. This occurred in the case reported by Hall.

According to Schumann, obstruction of the non-gravid horn is fairly common since this structure enlarges concomitantly with but not to the same degree as the pregnant horn. The non-pregnant horn may encroach directly upon the birth canal and close it off from the descending presenting part, or it may act to displace the axis of the pregnant uterus from that of the pelvic canal and thereby lead to severe dystocia. Berkeley, Bonney and MacLeod believe that if the non-gravid horn remains below the head of the child and causes obstruction, cesarean section is the correct procedure. In a few instances, an obstructing horn which filled the pelvic cavity has been pushed up. It has been found by experience that it is never pulled up spontaneously during labor. Frequently the non-pregnant uterus contributes to fundic irregularities that are responsible for malposition of the fetus. However, Schauffler believes that these complications are recognizable and usually may be circumvented.

FIG. 28. CASE IX, A. S. Uterus duplex bicornis, bicollis; fetus aged 201 days in utero, breech presentation. The body of the fetus is in one uterus and the lower extremities have entered the other uterus through the defect in the septum. This was subsequently confirmed by cesarean section. This patient conceived after uterosalpingography.

FIG. 29. CASE IX, A. S. Roentgenogram of same patient as Figure 25. The fetus in utero is of 273 days' gestation; breech presentation. The body of the fetus is in one uterus and the feet are still in the other uterus.

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As is to be expected, in patients with double uterus there is a greatly increased frequency of breech and transverse presentation (Schumann, Smith). In my two cases, one patient (Case IX) had breech presentation at
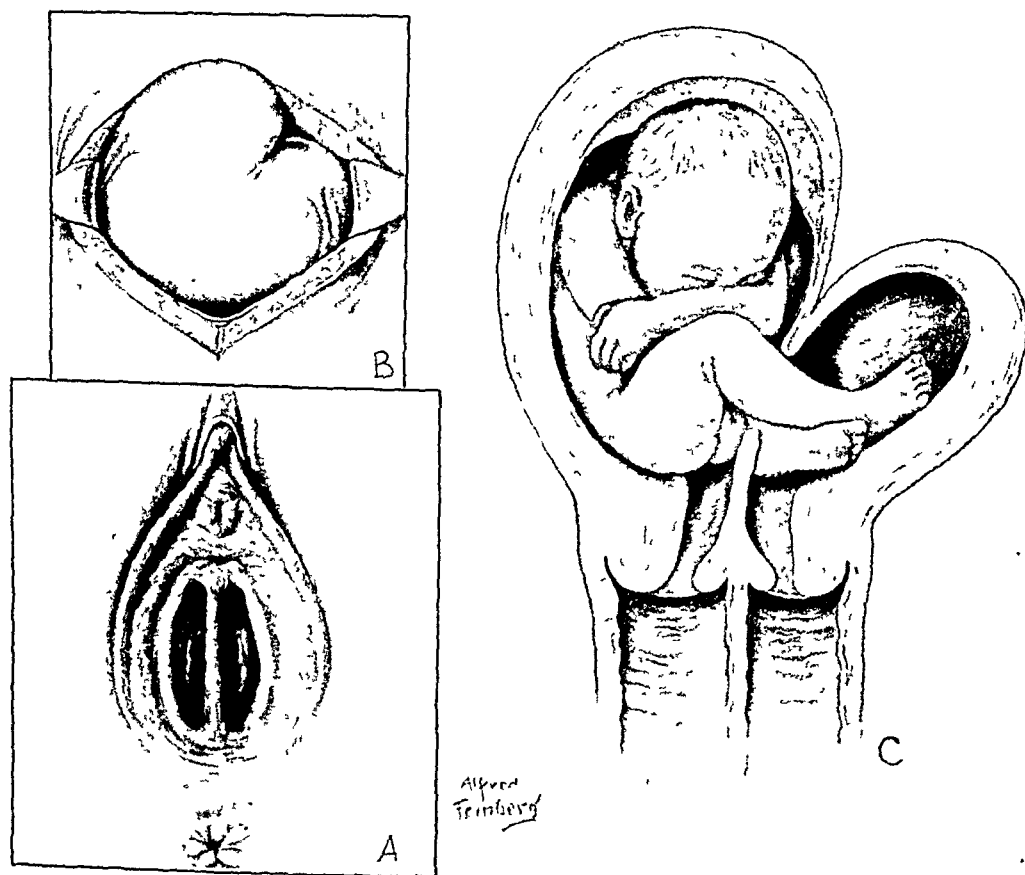
FIG. 30. CASE IX, A. S. Schematic drawing of genitalia of Case IX. A, Septum in vagina; B, anterior view of two uteri during cesarean section; C, coronal section showing both uteri. The entire body of the fetus is in the right uterus and the feet are in the left uterus. The baby had metatarsus varus. Note that during operation the appearance of the septum corroborated the findings of Figures 25 and 26.

each delivery. In Schauffler's series, of fifteen deliveries, four were breech presentations. In all the result was satisfactory. In the series of cases reported by Falls in 1939, breech presentation occurred fifteen times in the 134 patients delivered from below. This ratio (11 per cent) is in marked contrast to the general incidence of breech presentation (3.5 per cent). The babies in this group showed an uncorrected mortality of 13 per cent as against a general mortality in breech presentation of 7 per cent. Falls believes that the general mortality in breech presentation is such that it

is entirely unjustifiable to endanger the lives of these babies when the possibility of safe delivery from below is seriously jeopardized by dry labor, prolapsed cord, and inefficient uterine contractions.

A purely mechanical effect may result in the transverse position of a fetus with the head in one cavity of a uterus bicornis septus, the feet in another. (Figs. 25 to 30.) Sometimes the placenta may be on one side of a septate uterus and the fetus in the other (Frank). In one case reported by Berkeley, Bonney and MacLeod, roentgen examination revealed that the child lay partly in one horn and partly in the other.

UTERINE ANOMALIES AND CESAREAN SECTION

As is already evident, the indications for cesarean section occur with much greater frequency in patients with uterine malformation. Because of malposition, dystocia or both, the more extreme forms of bicornate uterus very frequently present an indication for cesarean section. It should be noted, however, that many obstetricians, like Shirley and Cogswell and Galloway, believe that such maldevelopments are not absolute indications for cesarean section. They are of the opinion that if pregnancy occurs and remains uncomplicated, the patient should be permitted to have a test of labor.

There are definite conditions under which cesarean section remains the most efficient and humane method of dealing with the problem and circumventing many complications. Many agree, for example, that incarceration of a non-gravid horn is usually an indication for the cesarean operation (Findley, Hardy, Moore). If the incarceration is accompanied by a breech presentation at term, it is an absolute indication for this method of delivery, according to Taylor.

In these cases the possibility of rupture of the uterus during labor is an important indication for cesarean section. Sometimes this operation is necessary because of persistent transverse presentation (Titus).

According to Smith the tendency to contracted pelvis also accounts for an increased incidence of cesarean section. In Falls' (1939) cases, in which 13.5 per cent of the patients were delivered by cesarean section, operative intervention was indicated chiefly by the combinations of contracted pelvis and arcuate uterus. Falls found that the results of conservatism in the management of these cases has been so disappointing as to warrant a more radical attitude. Operative intervention was elected especially in those cases in which premature rupture of the membranes complicated the problem of delivery, because long drawn out labor results in intrauterine infection and infection markedly increases the dangers of cesarean section if this operation becomes necessary. Marked irregularity or rapidity of the heart tones is another indication for termination of labor by cesarean section, but if the heart tones are normal and labor is progressing normally, even if

somewhat slowly, a conservative attitude is maintained and labor is allowed to go to spontaneous termination provided alarming symptoms on the part of the baby do not develop.

Schauffler recommends that surgical equipment be kept immediately available at the delivery of patients with uterine malformation. Such equipment may be necessary not only for the treatment of vaginal and cervical anomalies but also for possible cesarean section.

DIAGNOSIS OF UTERINE ANOMALIES

In only a comparatively small proportion of cases does the physician have the opportunity to discover a uterine malformation before the picture is complicated by pregnancy. In a large proportion of cases, anomaly is not suspected until difficulties arise during pregnancy or labor. In other instances the abnormality may be discovered during an examination for irrelevant symptoms requiring very thorough physical examination. Persistent or periodic pain may cause the patient to seek medical advice. Anspach states that where the uterus is double but the two horns are not equally developed, especially if one horn is atretic, the condition is more likely to become evident after puberty, when pain and other symptoms of gynatresia may appear.

In rare instances dyspareunia may be the chief complaint (Taylor). In several of my cases, sterility was the complaint that led the patient to seek medical advice.

A careful history will often elicit diagnostically valuable information. Definite menstrual irregularity, especially delayed menstruation or semimonthly flow, is a helpful hint and the occurrence of dysmenorrhea is suggestive. A history of interrupted pregnancies or abortions should also suggest the possibility of malformation of the uterus. (See Case vi.)

Some years ago Schwarz stated that women with a double uterus have unusually broad pelves. This observation has been confirmed (Schumann) but cannot be considered a dependable sign. The finding of a vaginal anomaly, such as a septum or other malformation, should at once raise the question of other abnormalities further up the genital tract. Examination of the cervix will often give further clues, a double cervix being indicative of uterus didelphys or uterus bicornis bicollis. The insertion of a sound, while contraindicated if pregnancy is suspected or present, will often give more positive information regarding the condition within the uterus itself. Caution should be exercised in passing metallic sounds to avoid injury or even perforation of the uterine wall. (Figs. 31, 32 and 33.)

Simple abdominovaginal palpation may enable the physician to feel a broadening or an indentation of the fundus. However, Schauffler is of the opinion that simple bimanual examination, in the absence of other suggestive signs, is not likely to clarify the situation. During pregnancy, palpa-

tion is more likely to give useful information that will enable the physician to diagnose and differentiate a uterine malformation from tumors or other lesions. Usually the uterus will appear larger on one side than the other,

Fig. 31. Case x, E. J. Uterus didelphys. Roentgenogram after introduction of a sound into each uterus.

and frequently the development of the body of the uterus will be eccentric (Falls 1939).

Uterosalpingography. It has long been my opinion that uterosalpingography is one of the most valuable means available to the gynecologist and obstetrician for the diagnosis of uterine malformations. I have devoted many years of study to this means of diagnosis and emphasize especially the safety of the procedure. It is gratifying to observe that other investigators also have found this method of great diagnostic value.

Since it can be used with a degree of safety, uterosalpingography should be a routine procedure in all cases in which anomaly is suspected. Properly performed, with necessary precautions, uterosalpingography provides an excellent means for the roentgen visualization of the internal genital organs through the use of opaque media such as iodized oils, or the newer and more readily absorbable opaque media.

In many gynecological disturbances, such as obstruction and diseases of the tubes, tumors of the uterus and uterine malformations, uterosalpingog-

Fig. 32. Case x, E. J. Uterosalpingogram shows two distinctly separate uteri with one fallopian tube in each. Observe opaque medium in a sinus connecting the supravaginal portion of both cervices.

Fig. 33. Case x, E. J. Vaginogram of septate vagina. Note recesses in each vagina.

raphy gives exact information that can be obtained by no other means. Even when diagnosis of a gynecological condition can be made without the aid of uterosalpingography, this procedure adds a definite element of exactness as to the type of malformation or other pathologic conditions.
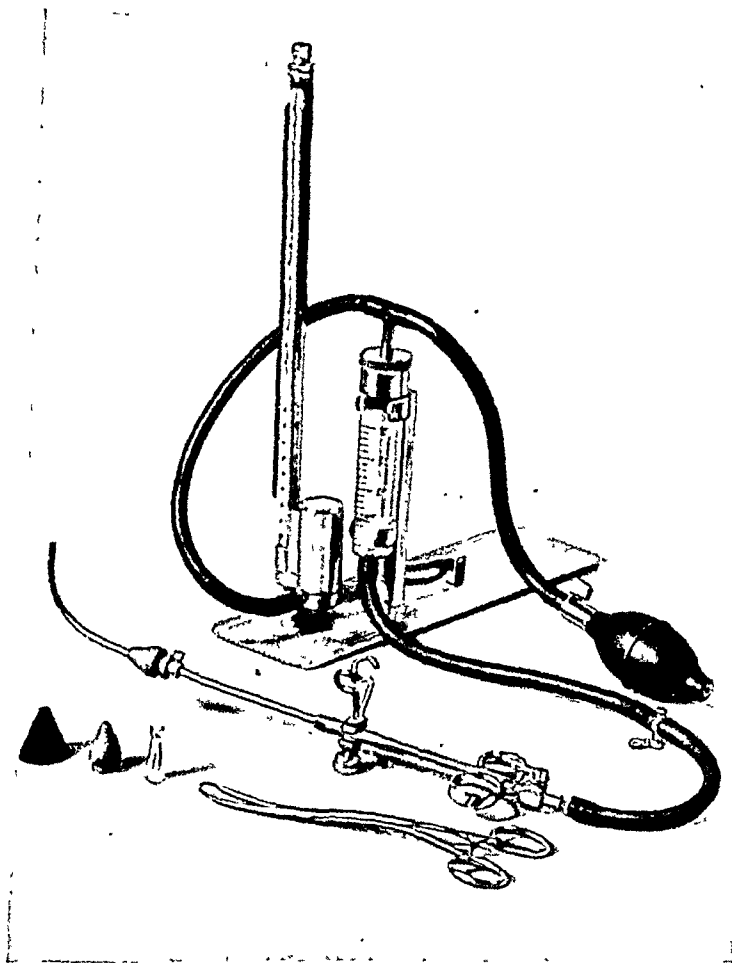
FIG. 34. Jarcho Pressometer for introduction of opaque media into the female genital organs in doing uterosalpingography. It is used also for retrograde pyelography. The above photograph illustrates the Jarcho Pressometer complete. Below the instrument are shown the rubber cone tip, the rubber acorn tip, the pyelographic glass catheter adapter and Jarcho tenaculum.

Uterosalpingography is contraindicated in the presence of heart disease, gonorrhea and acute tubal inflammation, malignant growths of the uterus (because of the danger of carrying cancer cells into the peritoneal cavity), menstruation and profuse bleeding and pregnancy.

FIG. 35. CASE XI, S. L. Uterosalpingogram showing indentation in the uterine shadow produced by a fibroid tumor which simulates uterus bicornis. The left tube is patent. The right tube is occluded at the cornual end. This defect was produced by a small fibroid in the right cornu, as indicated by arrow No. 2. (From Julius Jarcho, in *Surg., Gynec & Obst.,* 46: 752, 1928. By permission of publishers)

FIG. 36 CASE XII, R. C Elongation of right cornu (reader's right). Uterosalpingogram for primary sterility. The tubes were occluded and became patent. A large amount of opaque medium is exuding from the ostia abdominalia. (See also Case II.)

The Jarcho Pressometer. The author has introduced a special instrument for uterosalpingography, the pressometer. This instrument facilitates introduction of gases and opaque media into the uterine cavity and has
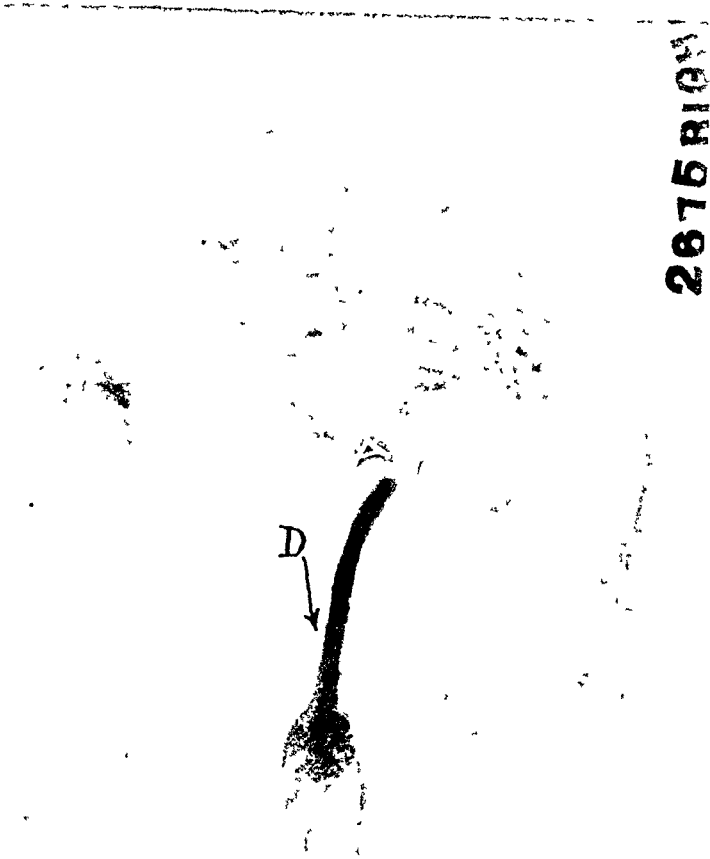
Fig. 37. CASE XIII, S. D. Uterogram of poorly developed uterus bicornis. (From Julius Jarcho, in *Surg., Gynec. & Obst.*, 46: 752, 1928. By permission of publishers.)

proved a valuable aid in diagnosing uterine malformations. The pressometer consists of reservoir equipped with a manometer by means of which the operator can measure the amount of pressure under which the opaque medium is introduced into the genitalia, as well as the quantity of medium injected. By employing the special catheter adapter the pressometer can be used for retrograde pyelography. (Fig. 34.)

Uterosalpingography does not render unnecessary the acumen of the examining physician, nor does it supplant a careful history, a thorough physical examination, and balanced judgment.

It would be superfluous to give the details of the transuterine introduction of the opaque media and the methods for taking the roentgenograms

because they have been described frequently in the literature. However, I believe that I should comment briefly on the importance of careful analysis of all uterosalpingograms and to stress the fact that the physician should not hesitate to seek the advice and cooperation of roentgenologists. In this connection, I recall a roentgenogram published in one of my papers (1928) which, upon hasty examination, might easily have led to the diagnosis of bicornate uterus. Upon closer study, however, the malformation was found to be due to pressure of a fibroid tumor on the fundus of the uterus, producing a filling defect in the uterogram, thereby simulating double uterus. (Fig. 35.)

A more accurate diagnosis made with the help of uterosalpingography is a major factor in determining whether or not a surgical procedure may be employed to correct a uterine malformation. Luikart, for example, placed great reliance upon the use of uterosalpingography to help visualize the difficulties which may be met if an attempt is made to remove a uterine septum. His paper covers the technic of removal of the septum of uterus septus and subsequent deliveries at term. It was observed in two cases that there was no disturbance of the contraction of the uterus following removal of the septa. (Figs. 36 and 37.)

SURGICAL CORRECTION OF GENITAL ANOMALIES

Procedures for the surgical correction of various uterine malformations have been reported quite frequently in the literature. Like Strassmann, Granberry and Faust, Sweet and others, I believe that in the absence of specific indications such as complicating pathological conditions, sterility, or very probable danger in the event of pregnancy, it is seldom necessary to operate merely for the sake of correcting an abnormality. Surgical measures based solely on the presence of an anomaly are seldom justified.

Over a decade ago, Smith said that the necessity for operative correction in these cases had been greatly exaggerated and I have noted that most contemporary writers maintain a conservative attitude with regard to such intervention. This attitude is apparent in Schauffler's paper. For example, he is of the opinion that elective operation for sterilization should be justified only by serious results from previous pregnancies or other pathological conditions which indicate the operation.

Some authors believe that plastic reconstruction of the uterus to form a single organ may sometimes be resorted to in the hope of a successful future pregnancy (Moore, Campbell). Often, however, the hoped-for event does not materialize even with metroplasty. Thus, Berkeley, Bonney and MacLeod reported that although they had performed such operations several times, the patients did not become pregnant. Rhemann obtained better results; the use of the Strassmann plastic operation in thirty-seven cases was followed by pregnancy in eleven patients. He states, however,

that in cases of double uterus this operation is justified only when the malformation is responsible for habitual abortion and premature labor and the patient seeks relief of these conditions. In view of the dangers and risks involved in pregnancy, Snyder believes that plastic reconstruction is a doubtful benefit. It is his view that sterilization would seem to be the preferable procedure in most cases.

The advisability of obliterating an intrauterine septum by excision or electrosurgery is questioned by Schauffler. Nonetheless; there are times when such removal becomes necessary. In Luikart's cases, for example, removal of the septa was indicated by previous miscarriages and abortions. Removal of the septum in each instance resulted in successful delivery of normal babies at term.

Removal of vaginal septa is sometimes necessary in order to obtain free drainage of uterine secretions (Snyder). In other instances, as in the case of double uterus, cervix and vagina reported by Obenour, removal of the vaginal septum eliminates the pain which sometimes accompanies sexual intercourse.

Sometimes an opportunity presents itself to improve conditions during the course of an unrelated operation, provided the condition is known, as in Eisaman's case, and the surgeon is unusually alert. In Eisaman's case, appendectomy was performed and an incidental plastic operation was also done. The component parts of a uterus bicornis with extreme lateral flexion were placed upright in a more normal position; sterility was thereby relieved.

In one of my own cases (Case x), in which there was a uterus didelphys, an attempted metroplasty failed, and hysterectomy was necessary. In that patient a branched sinus connected the supravaginal cervices.

Surgical operations in cases of uterine malformation vary widely. It is quite obvious that no fixed rule or type of operation is applicable, since the extent of malformation varies from patient to patient. Wherever possible, surgical intervention should be conservative.

CASE REPORTS

The following case histories of patients who have come under my personal observation during the past few years will serve to illustrate the various types of uterine malformation and associated symptoms that may be seen in a medical practice devoted to gynecology and obstetrics.

CASE I. G. M., married fourteen years, age thirty-four, said her menses began at seventeen years, at intervals of twenty-eight days, with a duration of three days, and that they were painful. Her complaint was sterility.

Bimanual examination revealed two well formed vaginae and cervices. Two well developed uteri were palpable, the right being the larger. This was confirmed by uterosalpingography.

The patient had one abortion thirteen years ago at three months and was curetted because of prolonged bleeding. Curettage was followed by fever and severe abdominal pain. This illness lasted two weeks.

Diagnosis. Uterus didelphys. (See Figs. 3, 4 and 5.)

CASE II.   (Fig. 6.) D. B. was twenty-four years of age and was married five and one-half years. Menses began at eleven and one-half years, and occurred every twenty-eight days, with six or seven days' duration; the flow was normal. The patient had had three confinements, April 19, 1926, May 5, 1931, and October 16, 1935.

Two weeks before the end of the last pregnancy the patient suddenly developed strong tearing pains which supervened at frequent intervals. Membranes not ruptured. Roentgenogram showed fetus lying high above crests of ilium, the head in one cornu and the legs in the other.

Under deep anesthesia external cephalic version was performed. The head was held on the brim of the pelvis for nearly an hour. Pains practically ceased. Pituitrin 0.2 cc. was given to produce uterine contractions and facilitate engagement. The patient was delivered spontaneously of a six and one-half pound living baby. This complication may occur in a uterus of arcuate type or in uteri possessing a single greatly elongated cornu. (See Case XII, Fig. 36.)

CASE III.   A. S. was forty-two years of age and had been married eight years. Menses began at twelve years, and occurred every twenty-eight days, with five days' duration. Her chief complaints were large mass in the abdomen and frequent, prolonged and profuse menstruation. She had had no children and no abortions.

Abdominal and vaginal examination revealed the presence of a mass which extended from the umbilicus to the pubis and filled the entire lower abdomen. Polypi were found attached to the cervix.

Diagnosis: Fibromyoma of uterus, polypi of cervix.

Subtotal hysterectomy was performed. The postoperative diagnosis was fibromyoma of uterus; uterus unicornis; congenital absence of right cornu, tube and ovary. (Figs. 7 and 8.)

CASE IV.   M. C. was twenty-eight years of age and married four years. Menses began at fifteen years, and occurred every twenty-eight days, with two to three days' duration; the flow was moderate and painful. Her complaint was sterility.

Roentgen examination following peruterine injection of iodized oil showed the presence of uterus unicornis. (Fig. 9.)

CASE V.   J. F., age thirty-one was married at thirteen years of age. Menses began at sixteen years, and occurred every twenty-five days, with four to five days' duration. Her last menses began on July 11, 1940, i.e., forty days before admission to the hospital. She was gravida 3, para 2. She delivered living children thirteen years ago and nine years ago. Both of these pregnancies were complicated by toxemia, hypertension and edema; there were no convulsions. A third pregnancy occurred three years ago and terminated in a stillbirth at six months. The patient had gonorrhea ten years ago. Contraceptives had been used for the past three years.

She complained of right-sided abdominal pain which lasted for one month. Vaginal bleeding occurred for forty days. One month before admission the patient began to have pain in the right lower abdominal quadrant with radiation to the

right flank and loin. The pain was intermittent and moderately severe. On July 11, 1940, menstruation commenced. It continued for fourteen days, ceased for two days, then resumed and continued for twenty-four days longer. Bleeding was moderate in amount. There were no fever, chills or vomiting.

Physical examination revealed no masses palpable in the abdomen. Pelvic examination revealed a small cystorectocele. There was slight descent of the cervix which was drawn to the right and obliterated the right fornix. The cervix was also drawn forward by adhesions and lay close to the pubis. The uterus lay to the right. Extending from its left border and reaching almost to fundal level was a cystic mass which on vaginal examination could not be clearly mapped out, but which on rectovaginal examination appeared to extend posterolaterally and had the consistency and contour of cystic adnexal tumor.

Cystoscopic examination showed that the bladder mucosa was normal throughout. The left ureteral orifice was seen in the usual situation, but after a search of twenty minutes following the injection of indigo carmine which appeared on the left side in four minutes, no orifice or excretion of indigo carmine could be seen on the right side. A left pyelo-ureterogram was done with 12 cc. of 30 per cent hippuran solution. In view of the fact that no right kidney shadow appeared on the x-ray, and that there was no right renal shadow in the intravenous pyelogram, and that no orifice was seen in the bladder, it was inferred that the right kidney and ureter were congenitally absent.

Supravaginal hysterectomy and bilateral salpingo-oophorectomy were carried out.

Diagnosis: Double uterus; uterus bicornis, unicollis, vagina simplex; bilateral pyosalpinx, and absence of right kidney.

The pathologist's report indicated that there were bilateral pus tubes, two uteri and one cervix. (The illustration was prepared after the uterus had been split open. It shows that the two components of the uterus were connected only by the supravaginal portion of the cervix.) (Figs. 13 and 14.)

CASE VI. S. C., age twenty-eight, had been married five years. Menses began at twelve years, and occurred every twenty-eight days, with seven days' duration; there was no pain.

Four abortions occurred, the last one December 11, 1937. Peruterine injection of iodized oil was performed five months after the fourth abortion. The patient had her last menses on February 10, 1939, and started to bleed on April 19, 1939. She expelled a uterine cast which on microscopic examination proved to be decidual tissue. This came from the non-pregnant right uterus. (Fig. 15.) Five days later the patient started to bleed profusely from the pregnant left uterus. Some products of conception were expelled but bleeding continued and the left uterus was curetted. The curettements showed chorionic villi. (Fig. 16.)

Diagnosis: Uterus duplex, bicornis, bicollis; vagina septa. (Figs. 17 and 18.)

CASE VII. M. G., age twenty-four, had been married two years. Menses began at twelve and one-half years, and occurred every twenty-eight to thirty-four days, with seven to eight days' duration, and was very painful. Her complaint was sterility.

On vaginal examination the vagina was found to be traversed by a septum, which divided it into a comparatively spacious channel on the left side and a

narrower one on the right. There were two cervices and two uteri. By the introduction of sounds it was ascertained that the right cervix and uterus were larger than those on the left. The patient refused roentgenologic study.

The patient had been having intercourse in the wider left vagina, which led to the smaller left-sided uterus. She was instructed to retract the septum and have coitus in the right-sided vagina. This was done and conception followed immediately. She was delivered by cesarean section.

Two years later the patient again complained of sterility and again was instructed to retract the septum and have intercourse in the narrower vagina. Conception occurred again. She was again delivered by cesarean section.

Diagnosis: Uterus duplex, bicornis, bicollis; vagina septa. (Fig. 19.)

Case VIII. E. B., age twenty-one, was married one year. Menses began at twelve years, and occurred every twenty-eight days, with five days' duration. Dysmenorrhea was present the first two days of period. She had had no children. The last menses occurred October 21, 1940, and was normal. She was admitted to the hospital November 22, 1940. Her complaint was severe lower abdominal pain and vaginal bleeding of two days' duration.

Vaginal examination revealed that the uterus was retroflexed and sinistroverted. In the upper part of the vagina there was a septum directed obliquely toward the left lateral wall, forming a pocket on the right side of the septum. Urologic study showed normal kidneys and bladder. Uterosalpingography after injection of iodized oil showed absence of the right cornu and tube. The left tube was filled with the opaque medium and the opaque medium was disseminated in the peritoneal cavity. Vaginogram showed a filling defect caused by a septum in the middle of the vagina.

On January 10, 1941, the vaginal septum was excised and a septum in the cervical canal was revealed. The patient was discharged on January 25, 1941. On November 8, 1941, she was readmitted to the hospital in active labor after thirty-four weeks of gestation. A premature living female infant was delivered spontaneously. The baby died thirty hours after delivery. The third stage of labor was prolonged for thirty-five minutes because the placenta was caught in the cervical canal; it was removed manually. The patient was discharged on the tenth postpartum day in good condition.

Diagnosis: Uterus unicornis, uterus biforis; vagina septa. (Figs. 20 to 24.)

Case IX. A. S., age thirty, had been married eight years. Menses began at ten years, and occurred every thirty days, with five days' duration, and was occasionally painful. Her complaint was sterility.

Examination revealed septate vagina, two cervices and bicornate uterus. Uterosalpingogram revealed not only the bicornate uterus, but showed a defect in the septum between the two uteri. A sound put into the right cervix went into the left uterus and vice versa. The patient conceived shortly thereafter and was delivered by cesarean section. At the operation the septum between the uteri was found to be incomplete. The baby's body was in the larger right uterus and the feet were thrust through the defect in the septum into the smaller uterus. A living female baby was delivered with a mild degree of club-foot (metatarsus varus), which was treated successfully. Three years later another living baby was delivered by cesarean section.

Diagnosis: Uterus duplex, bicornis, bicollis; vagina septa. (Figs. 25 to 30.)

CASE X.   E. J., age twenty-three was unmarried, para 0, gravida 1. Menses began at thirteen years, and occurred every twenty-eight days. The last menstruation began September 15, 1936. She was admitted to the hospital October 25, 1936. Her chief complaints were lower abdominal pain for three months and bleeding for forty days.

An elastic mass was palpable on the right side of the abdomen. This mass apparently extended upward from the pelvis to within 6 cm. of the umbilicus. The vagina was divided in two by a septum. The cervix in the right vagina was effaced and small, the os admitting a fingertip. The cervix was thinned out with the result that the os occupied almost the entire cervix. This cervix was continuous upward with the elastic mass palpable through the abdomen. Evidently the elastic mass was a uterus three months pregnant. The cervix in the left vagina was conical and smaller in diameter than the examiner's fifth finger, the os being as big as a pinhole. This cervix continued upward into a mass about 4 cm. long which was apparently a non-gravid uterus.

On November 3, 1936, the patient expelled a fetus. On the next day, under general anesthesia, the placenta was removed from the right uterus and the right uterine cavity was swept over with a dull curette. At a later date roentgen studies showed the presence of uterus didelphys with one fallopian tube in each uterus. There was a sinus connecting the supravaginal portion of both cervices. (Fig. 32.) An attempted Strassmann plastic operation proved unsuccessful and hysterectomy was necessary. (Figs. 31 and 33.)

CASE XI.   S. L., age thirty-one, had been married two years. Menses began at thirteen years, and occurred every three weeks, with four days' duration; it was profuse and painful. Her complaints were primary sterility, frequent, prolonged, and profuse menstruation.

On bimanual examination, the uterus was found to be slightly enlarged, anteflexed and irregular. There were two uterine fibromas, one about 5 cm. in diameter at the fundus, its major portion apparently forming part of the uterine wall, the other about 3 cm. in diameter located at the right cornu. Peruterine insufflation with oxygen and injection of iodized oil was done. Uterosalpingogram outlined the indentation produced by the fibroma at the fundus and also showed that the right oviduct was occluded at the proximal end of its isthmic portion. The filling defect produced by the fibroid in this uterosalpingogram simulated bicornate uterus. This illustrates the importance of uterosalpingography. Myomectomy was performed. The patient subsequently conceived and was delivered of a healthy female baby by cesarean section at term. (Fig. 35.)

CASE XII.   R. C., age twenty-six had been married one year. Her complaint was sterility.

Examination revealed elongation of the right cornu. In such cases one can expect malpresentation of the fetus as in Figure 6. The head of the baby is in the smaller cornu and the extremities are caught in the elongated cornu. (Fig. 36.)

CASE XIII.   S. D., age thirty-eight, had been married five years. Menses began at fourteen years, and occurred every six to eight weeks, with three days' duration; it was moderately painful. Her complaint was sterility.

Bimanual examination disclosed a small uterus with a depression at the summit of the fundus, a conical cervix, pinhole os and single vagina.

After injection of iodized oil, the roentgenogram showed rudimentary bi-

Fig. 38. Case xiv, A. H. Uterus biforis (septate cervical canal); multiple adenomyomas; bilateral tubo-ovarian abscess. (Courtesy of Dr. Peter M. Murray.)

cornate uterus. The tubes were not visualized but free oil in the peritoneum indicated that they had filled and then emptied themselves into the abdominal cavity.

Diagnosis: Uterus bicornis, unicollis; vagina simplex. (Fig. 37.)

Case xiv. A. H. (Courtesy of Dr. Peter M. Murray). Operation was performed March 10, 1941.

Diagnosis: Adenomyoma uteri, bilateral tubo-ovarian abscess, uterus biforis (septum of cervix). (Fig. 38.)

Case xv. M. A. was married three and one-half years. She had no children and no abortions. Menses began at thirteen years, and occurred every thirty days, with six days' duration. The amount was normal and not painful. The last menses occurred July 20, 1944.

The patient had a marked indentation at the fundus. It was a typical uterus arcuatus. Roentgen pelvimetry at term showed that she had a justomajor pelvis (gynecoid-dolicopellic or anthropoid.) The true conjugate was 13.5 cm. The transverse diameter at the inlet was 12.5 cm. The volume of the true conjugate was 1,225 cc. The volume of the transverse diameter was 1,000 cc. The volume of the bi-ischial diameter was 600 cc. A brow presentation later became a left occipito-posterior position.

Onset of labor occurred at forty-one weeks. Labor was short, lasting only four hours, but the fetal heart sounds became slow and irregular. Low forceps were applied. A living baby was obtained. The third stage was normal.

Case xvi. J. C., age twenty-five, had been married two years. There had

been no children. Menses began at thirteen years, and occurred every twenty-eight days, with three to four days' duration.

Examination revealed a double uterus, two cervices, and double vagina. The patient did not submit to roentgenographic study, and therefore the exact type of malformation cannot be stated.

Probable Diagnosis: *Uterus didelphys.*

Case xvii.   R. Z., age twenty, unmarried, had never menstruated. Her complaint was amenorrhea.

Examination revealed a vagina 1 cm. deep. The left ovary was present but the right ovary and uterus were not felt. The patient did not submit to urologic study and therefore it could not be stated whether she had any congenital abnormalities of the urinary tract.

Case xviii.   S. J., age thirty-two, unmarried, had never menstruated.

Examination showed slight indentation where the introitus of vagina should be. Rectal examination revealed the presence of a small left ovary and the absence of a uterus. The patient had normal secondary sexual characteristics. Since no operation was performed it is impossible to state whether the uterus and right ovary were rudimentary or absent. The patient did not submit to urologic study; hence it could not be stated whether congenital abnormalities of the urinary tract were present.

Case xix.   C. B., age twenty-eight, married three months, had never menstruated. The patient had normal secondary sexual characteristics.

Rectal examination revealed the presence of two small ovaries but the uterus could not be palpated. There was no vagina, but only a depression about 1 cm. deep.

The vaginal depression was dilated with graduated metal dilators to permit sexual relations. The patient did not submit to urologic study.

SUMMARY

1. A review of malformation of the uterus, with special emphasis on the more recent American literature, has been presented.

2. The embryology of these malformations has been reviewed briefly. A simplified system of classification has been proposed and a description of the basic types of uterine anomalies has been given. The parallel has been drawn between these malformations in the human female and the existence of similar forms in lower animals.

3. The relative frequency of these malformations, particularly as found in hospital statistics, has been indicated.

4. The physiological effect of such malformations has been considered. The danger of anomaly when complicated by pregnancy and labor is emphasized.

5. Methods of diagnosing these malformations have been considered and the advantages of uterosalpingography emphasized.

6. Surgical correction has been discussed briefly and the importance of conservative measures stressed.

7. A series of case histories is presented.

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Editorial

IMPORTANT DIVIDING WALL BETWEEN CAUDAL HERNIATION AND PROLAPSE OF ABDOMINAL OR PELVIC VISCERA

THE great body cavity enclosed by walls known as the cephalad, ventrad, laterad, dorsad and caudad walls, furnishes housing for sensitive structures important to the body economy. While these enclosed structures make connections with functioning structures in other parts of the body and terminal opening connections, the walls are so woven around these terminals and connections, that in most instances the walls remain intact and impervious to escape efforts of enclosed viscerae and structures. To this, however, there are many exceptions, due to structural imperfections, weaknesses, traumas and forces which produce pressure on the walls and contents tending to cause escape of the latter through the former.

The change of the long axis of the body from the horizontal to the vertical position required an extensive engineering feat to provide for the extra weight thrown upon the caudal wall and to so fit the tract terminals into the new formed wall that the integrity of wall tract support would not suffer. If we take advantage of our opportunity for observation, however, there are many mammals that represent the former type of carriage and these teach us many lessons which we may not have followed in the change of position of the human.

In addition to the supporting structure of the walls, each visceral structure has its own ligament or mesentery, composed of peritoneum, connective tissues, nerves, blood vessels and lymphatics, which determine its position in the abdomen and most of these structures have a range of movement determined by increase or decrease of weight, by lengthening or shortening of its mesentery, by force of changing size or fullness of other organs. By the constant force of gravity the trend is almost always toward the lower wall, or toward an escape, but these tendencies may be changed by counter forces. These intra-abdominal movements, to a larger extent downward, are designated by cephaladward, ventradward, lateradward, dorsadward and caudadward. In humans this intra-abdominal movement is to the greatest extent caudadward, and second in extent perhaps ventradward, but under certain conditions there is a marked movement cephaladward.

More common, but perhaps less accurate terms for these intra-abdominal shifts,

drifts or movements are ptosis, descensus, prolapse, ascensus, ascent, backward, forward and lateral position or movement. These are largely the terms which indicate change of position. Another change of position in these structures is fairly common and toward, into and through an opening, defect or weak place in the wall. This may be in almost any direction if intra-abdominal pressure is considerable, but in a downward direction gravity is added to intra-abdominal pressure and so herniation is far more common through the caudad region and the caudoventrad region.

There is no difference of opinion about protrusions of viscerae into or through the abdominal wall constituting hernias in the cephalad, ventrad, laterad and dorsad walls. There should be no further difference of opinion in regard to protrusions through the caudad wall. They are abdominal organs forced by gravity and intra-abdominal pressure to protrude into and through the musculofascial caudal wall, known as the pelvic floor, through the anterior or posterior pelvic floor slit, usually enlarged by trauma. This definitely constitutes a hernia. There are many who admit that these are hernias, but find their adjustment too difficult when they want to become teachers and so write under the title of "Hysterectomy for Uterine Prolapse" or "Sigmoidopexy for Rectal Prolapse."

Here then is the dividing line between prolapse, an intra-abdominal faulty position, and herniation a visceral protrusion. Prolapse is a downward wandering of structures in the abdomen, and they may eventually reach the pelvis or the pelvic floor. Herniation is a wandering of viscera or intra-abdominal structure, into, through or outside the abdomenal wall and may in this caudal region be dangling between the patient's thighs. There was a downward trend in the abdomen that could be considered prolapse. Any structure that crosses the threshold of the musculofascial floor becomes a herniation and is subject to a

new line of evil influences, exposure, infection, irritations, pinching, constricted circulation, resulting in edema, ulceration, rough contacts, etc. This is so marked that there is a vast difference between the part of the bladder herniated and that in the pelvis. One part is above the musculofascial pelvic floor diaphragm and one part is below. A pelvic structure comes to the caudal wall a movable structure, it crosses and it is no longer just a movable structure; it has become a herniated structure with a hernial ring and harm-producing influences.

This musculofascial wall which lies between prolapse—downward wandering in the abdomen, and hernia—tissue wandering outside the abdomen, is the caudal wall, composed of five layers of fascia and three layers of musculature, "faulted" by clefts for tract terminals, and impaired by childbirth, trauma, or surgical oblique episiotomy, injury or destruction. If we have herniation, downward displacement is implied and accepted. We do not mention prolapse with a scrotal or femoral hernia. Gallbladder prolapse would have preceded gallbladder herniation, if found in an umbilical hernia; but to treat it on the basis of prolapse would lead to erroneous and harmful surgery. The dividing line is the hernial ring and to treat the major pathological condition, the minor instance is forgotten.

Ptosis, descensus and prolapse signify by etymology and common use, downward displacement, but in no sense hernia; for example, ptosis, descensus or prolapse of the stomach, gallbladder, transverse colon, kidney or other organ or combination of organs.

A familiar example in four-footed animals is prolapse of any structure toward the low point, the umbilicus. Protrusion of any abdominal contents through the umbilical opening, whether originally located near or far, is a hernia, but usually termed in a four-footed animal a rupture or a breach, but never a prolapse in spite of its definitely downward trend, and fre-

quently lack of peritoneal sac. The more common names of rupture and breach used in animals and in less scientific circles, in reference to hernias in the human, carries the implication of a trauma, a breaking through, a giving way of walls. Prolapse, ptosis, descensus implies no participation of the abdominal wall and frequently has not included the wall in the treatment of so-called visceral prolapse, which has been directed principally against "uterine prolapse" and "rectal prolapse."

Strangely significant, however, is the fact that these caudal hernias, treated by most surgeons under the name of uterine and rectal prolapses, have a higher percentage of definitely traumatized wall etiology than do all other hernias combined. In fact, extensive caudal herniation in non-childbearing women is a rarity, and childbearing women definitely trace their genital and rectal herniations to childbearing traumas in a large majority of instances, and a traumatized musculofascial ring can be palpated as of hernial size.

It seems uncontrovertible then that the terms ptosis, descensus and prolapse as applied to visceral structures, refer to conditions inside the abdominal wall, and the terms hernia, rupture, breach, and terms ending with the suffix "cele" refer to abdominal wall conditions in which structures are finding or have found their way through an opening. In regard to the caudal area the one set of terms means conditions above the pelvic floor, but having worked toward it, while the latter set of terms refers to defective pelvic floor with protrusion of viscera through these openings tending to travel lower.

In regard to the ancient vintage and almost universal use of the term "prolapse" to apply to escape of abdominal viscera through the caudal wall, but not through other portions of the wall, it seems appropriate to call attention to several terms which by their common suffix indicates that some one, even in older times, recognized the hernial nature of conditions which

are in other regions called hernias, but unwisely, called in this region prolapse and procidentia, words very poorly chosen etymologically to represent their meaning.

Beside having the merit of long use, these terms ending in "cele" signifying hernia, have the advantage of definite application to different limited parts which may have reached a hernial stage at a given time, such as urethrocele, cystocele, colpocele, rectocele, uterocele, proctocele, and enterocele, for which we might substitute megalo cul-de-sac when it remains above the pelvic floor, and might well employ the term cul-do-cele when it finds its way through the pelvic floor.

The above terms are self-explanatory as to the structure herniating, but there has been rather loose use of the terms as to what they may be herniating into or through. Cystocele is erroneously quite commonly used to mean a bulging of the bladder into the vagina. A rectocele is said by some to signify a prolapse of the rectum into the vagina, a use of the term quite as improper as the above. The common conception of an enterocele is that it is a large, low posterior cul-de-sac bulging into the vagina, a use of this term entirely unwarranted.

To clear up these misconceptions we may say that none of the terms are entitled to the suffix "cele" until they have fulfilled the requirements for a hernia, and none of them fulfill this requirement until some portion of the named structure passes through the abdominal wall, which here is the musculofascial pelvic floor. The pelvic organs of vagina, bladder, rectum, uterus, nor cul-de-sac, are hernial sacs, canals, tubes or repositories. On the other hand, they become the herniated structure when having passed below the pelvic floor:

Urethrocele.......... an inversion through the urethral opening through the pelvic floor

Urethro colpocele...... a herniation of the urethra and vagina through the pelvic floor slit

Colpocele	a slight herniation of vagina through the pelvic floor
Cysto colpocele	.. herniation of bladder and vaginal wall through the pelvic floor
Utero colpocele	. herniation of uterus and vagina through the pelvic floor
Urethro cysto recto colpo uterocele	an extensive herniation of urinary, genital, rectal tract through the anterior pelvic floor opening
Proctocele	herniation of rectum through posterior pelvic floor slit
Procto colpocele	same as recto colpocele
Entero colpocele	if and when they pass through the anterior pelvic floor slit
Entero proctocele	when they pass through the posterior pelvic floor slit
Enterocele, cul-do-cele	if and when the cul-de-sac passes through the pelvic floor between the vagina and rectum
Megalo cul-de-sac	a large posterior cul-de-sac not yet having herniated through the pelvic floor

The vagina does not herniate far without the bladder and rectal wall. The bladder does not herniate through the pelvic floor without being accompanied by the vagina, and the same could be said of the rectum herniating through the anterior pelvic floor slit.

It would then be quite improper to speak of a cystocele or rectocele. The usual conditions are urethro colpocele, urethro cysto colpocele, cysto colpocele, a recto colpocele, and utero colpocele and different combinations. The bladder, the rectum, and the uterus find no hernial ring until the pelvic floor ring is reached, and can constitute no herniation previous to this pelvic floor herniation.

The above rather extensive group of herniations of urethra, bladder, vagina, rectum, uterus and cul-de-sac, constitute a condition which could reasonably be called herniosis, for no one or several of these terms could be applied without leaving some portions out. The term herniosis implies pelvic injuries and defects of a widespread nature through which all or many of these "celes" are breaking through. Aside from these herniations and perhaps added to them, is shown a decided tendency to herniation in the umbilical, ventral, inguinal or/and femoral regions. I submit the term "herniosis" for careful consideration.

All conditions of loss of pelvic floor integrity with herniation of viscera require a careful engineering plan and reconstruction, as the hernioplastic repair must take into consideration not only efficiency of pelvic floor support, but urinary, genital and rectal supervision which calls for functional support without complete closure.

This calls for (1) adequate supporting reconstruction of the injured musculofascial caudal wall; (2) frequent repair of rectal wall and sphincter muscle; (3) at times closure of vesico- and rectovaginal fistula; (4) dissection of excessive scar tissue; (5) fascial support of bladder, vagina and rectum; (6) proper narrowing of sacculated rectum, vagina and bladder; (7) oblique placing of the narrowed vaginal tube directed from the symphysis upward and backward; (8) horizontal placing of the uterus, fundus forward, cervix backward; (9) equal attention should be given to reconstruction and placing of the vagina if the uterus requires removal; (10) normal position and placing of the uterus if left in, no hiding or burial operations, as abdominal wall burial, interbladder-vagina hiding of all or part of the uterus, the Le Fort interment, etc.; (11) above all, in restoring pelvic floor integrity we would emphasize no effort or carelessness in by-passing the musculofascial diaphragm, composed of five layers of fascia and three layers of muscle, so wisely formed to create pelvic floor integrity for the upright position; (12) successful repair of moderate pelvic floor injury need not contraindicate pregnancy or delivery through the normal route. After extensive and complicated successful repair, pregnancy may not be, and usually is not, contraindicated, but Cesarean section may be the wiser choice for delivery, on account of possible irreparable damage which might take place. (13) Ptosis, descensus, prolapse refers to the phenomenon of downward wandering or a lowered position of intra-abdominal

organs. Hernia, rupture, breach and the suffix "cele" refer to the "protrusion of viscera into, through, or outside, the abdominal wall in any direction or locality, whether floor, walls or roof, and regardless of presence or absence of peritoneal sac."

(Stone). (14) The break through of urethra, bladder, rectum, uterus, anterior and posterior cul-de-sacs with perhaps other important structures, may justly be termed *pelvic floor herniosis.*

CHANNING W. BARRETT, M.D.

Correction: We wish to correct an error made in our January 1946 issue. The illustration for Figure 21, on page 137 in Dr. Jarcho's article, was printed upside down. A correction is being made in the reprints.

Original Articles

URINARY INCONTINENCE*

WITH SPECIAL REFERENCE TO CERTAIN FACTORS WHICH ARE NECESSARY IN THE CURE OF THIS CONDITION

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PROBABLY no operation in gynecology is approached with as much apprehension from the standpoint of the end result as that for the cure of incontinence of urine in the female.

Kelly,[1] in his "Practice of Gynecology," states that "The list of the operations devised to overcome incontinence is legion, mostly unsuccessful but occasionally, temporarily at least, affording some control; again working by destroying tissue, or as in the twisting operation, ending in an extensive slough."

Over a period of years numerous operations have been devised for the cure of incontinence. Some have given temporary relief, others permanent relief, but until there is a better understanding of the anatomy of the urethra and the mechanism of its control, all operative procedures will remain in the stage of experimental surgery.

During the past few years there has been a vast improvement in the operative technic and the end results have been more gratifying. There still remain, however, the cases that seem to baffle all attempts at cure. Many times these cases have had previous operations and with each operation there is added trauma and destruction of tissue.

The various types of operation which have been devised for the cure of incontinence may be divided into several groups:

Kelly's[2] plication of the posterior portion of the urethra in the region of the vesical neck is probably the best known and most widely used. With this operation we associate the names of Ward, Rawls, Farrar and Finley Douglass. The use of contiguous muscle under the urethra in an effort to constrict it was advocated by Deming, H. Martius, Taussig, Stoeckel, Selheim and others. Combined plication[3] of the urethra and bladder was advocated by such surgeons as Bonney, J. G. Clark, Davies, Watson, Royston and Rose. Suprapubic plication of the vesical neck, was suggested by Furness. Other operations,[4] more rarely used at the present time, are the urethral advancement operation devised by Pawlick and improved by Dudley, and also the urethral, twisting with advancement, as used by Gersuny, Pawlick and Ries.

To the above may be added the newer operations as performed by Kennedy, Aldridge, Studdiford and Meigs. These surgeons have used wider dissections of the urethra and support under the urethra, either by metallic means or strips of fascia derived from the abdominal wall.

While this paper is not an attempt to offer anything radically new in the way of an operation for incontinence in the female, it is an effort to evaluate important steps in the operation and to describe a new technic for the support of the urethra and

* Presented before the New York Obstetrical Society May 8, 1945.

bladder, especially where the incontinence has been accompanied by a urethrocele and cystocele.

FIG. 1. 1, Urethra; 2, urethrocele; 3, cystocele.

It would seem that if the first operation were successful we will have gone far in solving this problem.

While urinary incontinence may be a separate entity, it is most commonly associated with urethrocele and cystocele of lesser or greater degree. The causative factor is most often birth trauma and the resultant hernia, vesico-urethral. At times, associated with this, there is a downward rotation of the urethra under the symphysis.

Before discussing the operative technic of these conditions, it may be both interesting and instructive to review briefly the history and development of anterior vaginal wall plastic surgery.

Modern plastic pelvic surgery owes its origin to the early attempts of gynecological surgeons to cure prolapse of the uterus. While these attempts were crude and unsatisfactory in the light of our present-day knowledge, they formed the basis upon which our present-day surgical technic has been developed.

The early part of the last century[5] marked the beginning of surgical efforts to replace the prolapsed uterus. These
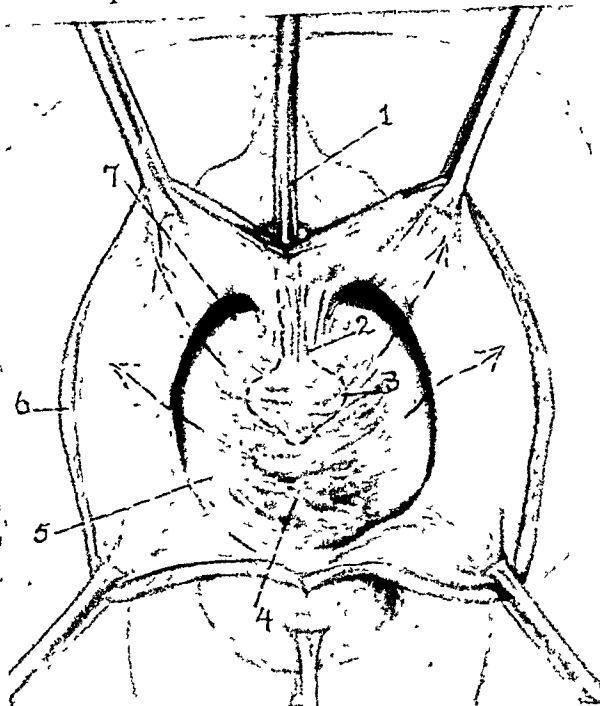
FIG. 2. 1, Mushroom catheter, size No. 12; 2, vesical neck of the bladder (note shortened urethra); 3, tip of mushroom catheter at site of urethrocele; 4, cystocele—note thinned out portion of bladder wall; 5, smooth capsule of bladder wall; 6, anterior vaginal wall; 7, area of dissection under the pubic rami.

efforts were directed mainly at replacing the uterus and endeavoring to secure its position by stricture of the vaginal canal by the use of caustics, cautery and chemical agents.

In 1823, Romaine Girardin suggested an operation for the occlusion of the vaginal canal, but it was not until 1828 that Dieffenbach first performed colporrhaphy for uterine prolapse. He accomplished this by excising areas on each side of the vaginal wall and closing the raw areas with sutures.

Heming, in 1831, denuded a strip of tissue from the anterior vaginal wall and placed interrupted sutures in an effort to raise the prolapsed uterus to a higher level.

The following year Ireland performed a similar operation, but modified it by

adding a denudation on each side of the anterior vaginal wall.

In 1849, Huguier called attention to the

Fig 3 1, Incision carried to within 1.5 cm. of external urethral meatus, 2, first suture placed high in the urethra; 3, second suture placed in region of the vesical neck, 4, remaining mattress sutures placed in region of cystocele; 5, anterior vaginal wall.

fact that in certain cases of uterine prolapse there was an elongation of the cervix and devised an operation for conical amputation of that part of the uterus.

Baker Brown, in 1853, performed an operation wherein he denuded the lower portion of the vulva and perineum by means of a horseshoe incision. The denuded areas were sutured with both deep and superficial sutures. If a cystocele were present, a further denudation was done on the labia, just below the external urinary meatus.

Stoltz, of Germany, Savage and Geddins performed similar operations at about the same time.

Both Sims and Emmet were familiar with Brown's technic and used it, but were disappointed with their results.

In 1856, Sims achieved his original colporrhaphy. This he did by accident

while attempting to cure a cystocele. To quote from Sims' original record. "My surprise was equalled only by my

Fig. 4. 1, Space under the pubic rami with free mobilization of the urethra; 2, first row of sutures tied, 3, second row of sutures in the bladder; 4, anterior vaginal wall, 5, smooth capsule of bladder wall.

delight, when I found that I had not succeeded in doing what I had intended, for instead of excising the base of the bladder with the anterior wall of the vagina I had by the tenaculum, simply raised the hypertrophied vaginal tissue up between the blades of the forceps, luckily separating it from the living membrane of the bladder."

Two years later Sims abandoned his exposure of the bladder and adopted his V-shaped denudation operation.

In 1862, Emmet converted Sims' V-shaped incision into a triangular denudation, and in the same year Sims modified his own incision and adopted a trowel-shaped denudation.

In cases complicated by an excess of tissue around the urethra or with a urethrocele, Emmet used a heart-shaped

denudation in addition to his denudation of the anterior vaginal wall.

To Emmet must be given the credit for

wall from the bladder, improvised an instrument which he passed through a small incision in the vaginal wall.
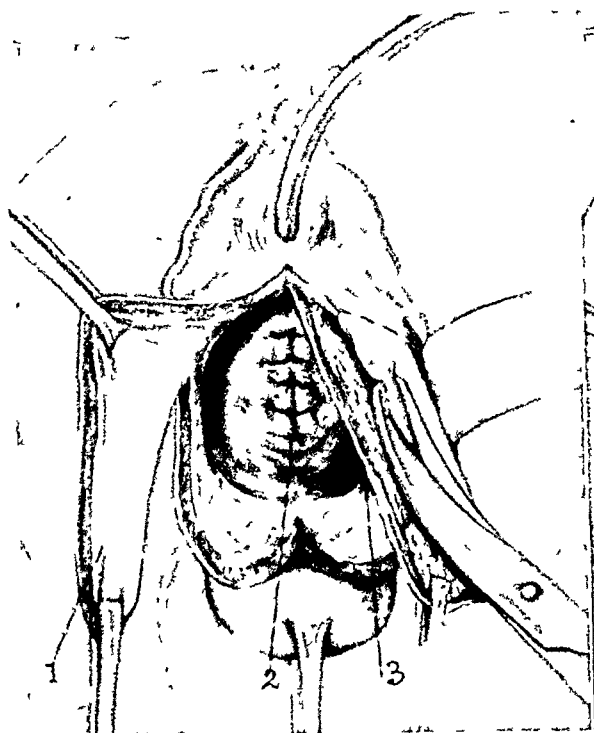
FIG. 5. 1, Strip of tissue from the anterior vaginal wall (entire thickness); 2, second row of sutures in the bladder; 3, denuding the mucous membrane from the strip of the anterior vaginal wall.
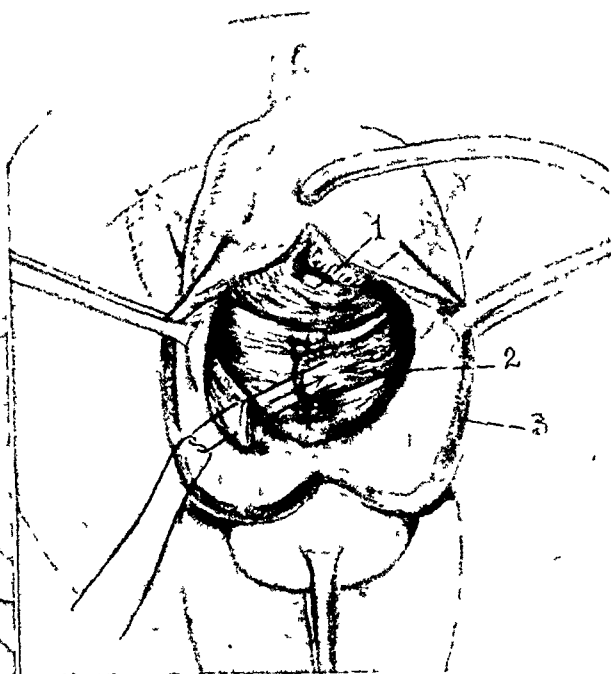
FIG. 6. 1, Strip of tissue from the right side of the anterior vaginal wall sutured under the pubic rami of the left side; 2, excess portion of tissue sutured to that of the opposite side in the region of the vesical neck; 3, anterior vaginal wall.

first recognizing the importance of the fascia of the anterior vaginal wall as a means of support in prolapse of the uterus. He said of his operation for prolapse "that a direct lateral support is gained from the pelvic fascia."

Emmet's anatomical findings were not generally recognized and there was a return to the older methods of attempts at occlusion.

In 1888, Donald, of Manchester, England, performed five operations for uterine prolapse by means of an anterior and posterior colporrhaphy. This he did by means of a wide, diamond-shaped incision, including excision of the cervix, and drew the deep tissues together with a buried spiral suture of catgut.

In 1872, Thomas, realizing the importance of separating the anterior vaginal

It was not until 1887 that Hadra,[8] of Texas, first suggested "flap-splitting" of the anterior wall of the vagina and the freeing of the bladder from the cervix. One year later he published his findings, but they were not generally adopted until many years later.

The following year Sanger and Noble used the general method of Hadra and improved the technic of his operation.

Munde was probably the first to describe cystocele as a hernia, while Skene was the first to operate on a cystocele from the standpoint of a hernia. A few years later Gersuny adopted the method of elevating the bladder by means of a purse-string suture passed into the fascia of the anterior vaginal wall.

J. Riddle Goffe, in 1902, advocated a wide dissection of the bladder so as to free

it from its attachment to the vagina and cervix. He recommended that the excess of bladder wall be transposed to the peri-

FIG. 7. Closure of anterior vaginal wall with interrupted sutures.

toneal cavity and sutured to the body of the uterus and broad ligaments.

In Manchester, England, Donald's operation for anterior and posterior colporrhaphy had been steadily extended and had given excellent results. Fothergill, a pupil of Donald, had written extensively of this operation and emphasized the necessity of using deep sutures in the base of the broad ligaments to augment the support of the uterus.

In this country and in Germany the tendency was more towards flap-splitting, free mobilization of the bladder with advancement, and the use of the so-called uteropubic ligaments for bladder support.

This type of operation was performed by Stone[9] in 1901 and later by Kreutzmann, Sipple and Violet. A similar operation was described by Martin in 1911.

In 1917, Frank and Rawls published papers describing an operative technic for cystocele. Rawls' operation advocated the fascia-lapping of Bissell for support of the bladder.

Halban, in 1919, advocated free mobilization of the bladder from the uterus and fascia. He then severed the vesicovaginal fascia at the level of the internal os. A purse-string suture was used to gather up the excessive fascia and attach it to the cervix at the level of the internal os.

Ward, in 1919, presented his operation for cystocele and advocated the use of the uteropubic fascial ligaments to reinforce the support of the bladder. This operation he termed "cystopexy" and stated it to be a combination of the operations of Hadra, Goffe, Martin, Frank, Alexandroff and Sims.

In 1929, Bissell studied sections from the anterior vaginal wall and found that they contained no definite fascial layer which could be defined as such. He believed that most of the support came from the musculature of the vaginal wall and that the lapping of this musculature gave added strength and support.

Goff's histological studies bore out the findings of Bissell. His conclusions were: "The successful surgical correction of cystocele, rectocele and urethrocele depends on the utilization of the tissue of the vaginal wall rather than on the use of the fragile areolar fascia which surrounds it."

J. G. Clark's operation[10] for anterior colpoplasty was a radical departure from the ideas of his contemporaries. He advocated complete separation of the anterior vaginal wall from the bladder. This separation was carried well down on the sides of the bladder and exposed the urethra to its upper third. Clark stressed that in removing the vaginal wall from the bladder care should be taken "to leave the thin aponeurotic membrane which will be found investing the bladder." He further stated: "This will be seen to be slender and attenuated at the center of the cystocele, but strong and well marked on the sides." He then sutured the bladder, using a continuous suture to infold the bladder.

This suture was carried well out on the sides so as to include the aforementioned "aponeurotic investure." If incontinence accompanied the cystocele, three mattress sutures were placed through the vaginal wall directly over the urethra.

Davies,[11] in 1939, published an article on cystocele in which he described hernia of the bladder to be due to a rupture of the mesovesico. He advocated complete mobilization of the bladder from both the cervix and vaginal wall and stated: "A smooth, glistening, fibrous tissue intimately attached to the bladder is exposed lateral to the roughened bleeding area which represents the midline tear through which the bladder herniates." He recommended that mattress sutures be placed in the bladder wall to close this hernial opening.

Kennedy,[12] in his operation for incontinence, also emphasizes the necessity of complete mobilization of the bladder and urethra. This is accomplished by carrying the vaginal wall incision from the cervix to within 1.5 cm. of the external urinary meatus. The dissection is then carried laterally to the pubic rami on each side. All adhesions between the urethra and the pubic rami are separated and the dissection is extended to the paravesical space and under the symphysis on both sides, thus completely mobilizing the urethra and the bladder.

In 1942, Aldridge[13] published an operation for stress incontinence. This operation utilizes fascial strips from the aponeurosis of the oblique muscles. These strips are passed downward under the pubic bone and sutured under the urethra to form a sling support.

A great deal of credit must be given to Kennedy[14] for his work in demonstrating and defining the various "states" of the bladder. This he accomplished by means of x-ray graphs, using an ingenious instrument made up of a small sac attached to a manometer and inserted into the bladder. This sac, containing a media, in conjunction with a contrast media in the bladder, shows not only the contour of the bladder but the outline of the urethra as well.

Kennedy[15] describes three "states" of the normal bladder, namely, "the holding state," "the relaxing state," and "the voiding state." The incontinent patient remains constantly in the voiding state and is unable to resume the normal holding state due to the relaxation of the vesical neck and the lack of control of the voluntary muscle of the urethra.

In early gynecology[16] the term urethrocele was used only in referring to a sacculated urethra, sinus of the urethra or urethral diverticulum. In later years the term has been used more generally in the sense of a definite hernial protrusion of the urethra in the region of the vesical sphincter.

Graves[17] says: "The descent of the bladder may include the urethra, and when this takes place the condition is termed urethrocele. Urethrocele is usually only an incidental part of the process of cystocele but may occur alone."

Curtis[18] states that urethrocele is a prolapse caused by a laceration of the supporting vesicovaginal fascia, causing the urethra to rotate downward around the pubic bone. Furthermore, he adds that relaxation of the vesical sphincter is commonly present.

If the vesical sphincter constitutes the normal division between the bladder and the urethra, it therefore must be the dividing line between a urethrocele and a cystocele. In many cases where the vesical sphincter is relaxed, there is a merging of these conditions, thus causing a combined cysto-urethrocele.

Hernial protrusion of the bladder, commonly spoken of as cystocele, is more often a combined cysto-urethrocele, involving the base of the bladder and urethra in the region of the vesical neck. This condition would naturally shorten the urethra, as measured from the vesical sphincter to the external meatus.

The length of the normal urethra, according to Piersol,[19] is about 4 cm. During

the past few years it has been our practice to measure the urethra in all patients with incontinence, urethrocele and cystocele. For this purpose we use a No. 12 F. mushroom catheter marked off in centimeters.

We have found that the incontinent patient with a urethrocele and cystocele invariably has a relaxed *vesical sphincter and shortened urethra*. However, this condition is not confined to the incontinent patient because it is found frequently in patients with cystocele and urethrocele *who are not incontinent*.

This fact leads us to the natural conclusion that a *relaxed vesical sphincter is not the sole cause of incontinence*, but that added factors play a part in producing this condition. These undoubtedly include damage of the voluntary muscle system of the urethra. If this is true, the mere tightening of the neck of the bladder by plication and failure to correct the damaged urethral muscle, may be the explanation of many of our operative failures.

Because of the close association of *incontinence, urethrocele and cystocele* and the fact that incontinence is but a result of further damage to the urethra by the original trauma, it would seem rational that operative treatment should be directed primarily to the bladder and urethra.

The successful treatment of any hernia consists in ligation of the sac, restoration of the herniated part to its normal habitus and support of the area where the hernia originally developed.

The improvement in the operative results in vesicovaginal fistula was due to the realization of the fact that a freely mobilized bladder was necessary to the placing of the sutures without tension. This corollary should be applied to the operation for incontinence. Plication of the bladder without tension is essential.

In order freely to mobilize the bladder all adhesions must be separated. This includes separation of the bladder from the anterior vaginal wall, posteriorly from the cervix

as far as the uterovesical fold, laterally until the vesicovaginal fascia is visualized as a smooth capsule, and upward laterally under the pubic rami on each side to free the urethra. The operative procedure is as follows:

At the cervicovaginal junction an incision is made through the complete thickness of the anterior vaginal wall to the vesicovaginal areolar fascia. At this natural line of cleavage the anterior vaginal wall is incised in the midline, exposing the bladder.

With a gauze-covered finger the bladder is separated from the anterior vaginal wall and the incision in the vaginal wall is carried to within 1.5 cm. of the external urinary meatus.

The bladder is now separated from its fascial attachments and freely mobilized. At this point a No. 12 F. mushroom catheter, marked off in centimeters, is inserted into the bladder to localize the vesical sphincter, and left in place until the completion of the operation.

Plication of the urethra and vesical sphincter is accomplished by the use of an intestinal atraumatic No. 00 chromic catgut suture.

Mattress sutures are placed, beginning just below the external meatus and carried posteriorly to the base of the bladder, including the vesical sphincter. The point of starting is optional as some operators prefer to begin the plication in the region of the vesical neck.

Care must be observed not to constrict the ureteral orifices at this point, as they lie posteriorly about 3 cm. from the vesical sphincter.

A second row of sutures is placed in the same manner, invaginating the first row.

The vesicovaginal fascia will be seen to be attenuated in the region of the vesical sphincter. This part of the bladder requires special attention as the stronger vesicovaginal fascia is at the sides of the bladder and must be approximated in the midline. This is the weak point of a cystocele and urethrocele.

Additional support should be given to the repaired urethra and neck of the bladder.

Because of the presence of voluntary muscle tissue contained in the anterior vaginal wall, it occurred to us that if we could use this tissue it would aid materially in improving the control of the repaired urethra and help to maintain the urethra and bladder in their normal positions.

This is especially desirable where there has been a downward rotation of the urethra.

This procedure is as follows:

Two strips of tissue 4 cm. in width are excised longitudinally from the whole thickness of the anterior vaginal wall on either side of the original mid-line incision. These strips are left attached at their point of fusion with the urethra.

Both tissue strips are carefully denuded of their mucous membrane, crossed under the urethra and sutured to the under-surface of the symphysis, each on its respective side.

These sutures are carried first through the periosteum of the symphysis as close to the White line as possible, and then through the strips of tissue about 3 cm. from their point of attachment to the urethra. When these sutures are tied the urethra is drawn upwards and backwards under the symphysis and is maintained in this position by the sling effect of the crossed tissue strips.

The excess distal portion of the strips are now sutured to one another in the region of the vesical neck of the bladder. This suture should include a portion of the bladder. The urethra and bladder now have the advantage of a double support.

The anterior vaginal wall is now closed by interrupted sutures and a Kennedy vitallium catheter and packer are installed and left in place for seven days. This allows the sutured urethra and bladder wall to heal without interference.

CONCLUSIONS

1. Free mobilization of the urethra and bladder is important in the cure of incontinence of urine in the female.

2. Plication of the urethra and base of the bladder should be done without tension.

3. Plication should include the urethra from a point just below and lateral to the external urinary meatus and continued posteriorly to a point which includes the vesical sphincter, thus lengthening the urethra, repairing the damaged voluntary muscle and relaxed vesical sphincter.

4. Added support to the urethra and bladder by means of tissue strips excised from the anterior vaginal wall, and sutured to the undersurface of the symphysis and vesical neck, respectively.

5. Incontinence of urine in the female should be considered as the result of a damaged bladder and not as a separate entity. Its treatment should be directed toward restoring the urethra, vesical sphincter and base of the bladder to their normal anatomical relationships.

6. If these facts are kept in mind, we shall have gone far in arriving at a solution of this troublesome problem.

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IN the overwhelming majority of cases laceration of the genital canal are due to childbirth, but other forms of trauma, such as coitus, attempted rape, or external violence may at times be responsible. The cervix and perineum are the usual seats of lacerations of the obstetrical type.

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ESSENTIAL HYPERTENSION

AN EXAMINATION OF ITS MECHANISM IN RELATION TO SURGICAL TREATMENT

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DURING the last fifteen years increasing prominence has been given to the problem of hypertension and the relief of this condition by surgical measures. A study of the literature reveals some uncertainty of opinion both with regard to the clinical syndrome and its relationship to renal and adrenosympathetic pathology. It is the objective of this paper to endeavor to correlate the clinical types, which the hypertensive condition presents, with the knowledge derived from the very considerable experimental research work that has been carried out, and upon this basis, to attempt an evaluation of the position of surgical treatment. Essential hypertension is associated with two broad physiopathological features. First, tissue change in the vascular system particularly in the renal vessels, and secondly, an instability of the balance of the adrenosympathetic neurochemical apparatus.

The importance of renal ischemia and associated fall of renal pulse pressure has been shown to be fundamental in the etiology of at least one type of hypertension. This introduces a primary factor in the solution of the mechanism involved, namely, the causation of the hyperplastic and degenerative changes in the cells composing the walls of the blood vessels.

Much of the experimental work carried out in recent years, both in America and Europe, on the production of hypertension in the laboratory animal must be linked with the earlier investigations upon the production of vascular tissue change. Prior to the onset of cardiovascular damage, the increased pressure is principally dependent upon the rise of the peripheral resistance to the blood flow, cardiac output and viscosity of the circulating blood being unaltered pressure factors. The problem is therefore narrowed to the cardinal issue as to the causation of the increased resistance of the arterioles, whether transient and paroxysmal, or permanent and progressive to the point of lumenal blockage.

In 1897, Cehanovic reported connective tissue cell hyperplasia and nuclear changes in the muscle cells of the tunica media of blood vessels after severance of their sympathetic innervation. About the same time, von Bechterew concluded that the effect of sympathectomy on the blood vessels was an increase of elastic tissue both in the intima and the media accompanied by muscle cell hyperplasia. This work was followed up by Lapinski in 1908. He examined the arteries of the rabbit's ear after division of the cervical sympathetic supply and found that out of a series of fourteen animals, seven showed rapidly atrophy of the medial muscle cells at focal points, in others there was hypertrophy of these cells, while many of the animals exhibited hyperplasia of the intima.

The next development of the problem came from the work of Manouèlian in 1913. He showed that atheroma of the abdominal aorta in dogs was the sequel to the division of a specially selected and fairly constant sympathetic fiber which entered the vessel near the origin of the left renal artery.

About this same period, the investigations of Todd and Stopford demonstrated that the pressure of a cervical rib or associated fibrous bands upon the sympathetic fibers lying in the lowest brachial cord

was followed by a precisely similar series of degenerative changes in the arteries distal to the pressure. It was specially observed that the endothelium of the intima showed considerable proliferation along with the increase of elastic tissue, the muscle cells of the media were also hyperplastic.

During the World War I, the researches of Stopford on cases of peripheral nerve injury showed that tissue change of a similar type occurred in the distal blood vessels of those limbs subjected to irritative lesions of their peripheral nerves.

Retrogressing to an earlier observation made by Pearce in 1906, he discovered that the injection of fractional doses of adrenalin produced in rabbits the same series of vascular tissue changes found to follow division of their sympathetic innervation. These changes were comparable to those following neural irritation in the human subject. Confirmation of this observation was obtained in 1920 by Polettini at Turin.

In 1924, I took up the investigation and starting from the hypothesis that proliferative and subsequently degenerative cell reaction in the walls of blood vessels is due to irritation or section of their nerve supply, I decided to produce chronic fibrotic irritation of the sympathetic nerves and study the effect on the blood vessels within their area of distribution. Repeating the earlier work of Pearce and Polettini, I was not successful in obtaining similar results from adrenalin injections, but in a series of animals subjected to daily electric stimulation of the cervical sympathetic in addition to adrenalin injections, there was definite evidence of tissue change as compared with the controls. Degeneration of the muscle cells of the media with fatty deposition in focal necrotic areas was combined with proliferation of both the intimal endothelium and of the elastica, which had become fragmentary. The excitation of chronic fibrosis by means of submerged skin tubes sutured around the cardio-aortic nerve supply produced, in a high percentage of the animals, changes both in the intima and the media of a similar nature. The completion of the evidence linking vascular cell balance with the adrenosympathetic system came from the work of Nicolo Maggi and Ernest Mazochi in 1933. They grafted adrenals in rabbits and succeeded in obtaining the same graded series of arterial tissue change. Their results were confirmed by Leriche's pupil, Froehlich,[1] who introduced adrenal grafts beneath the skin of rabbits at four-day intervals. The number of grafts was graded, as many as forty being inserted in some animals, and in all of them progressive arterial change was found comparable to that following neural irritation. It was concluded that the increased adrenalin produced leading to abnormal stimulation of the vasopressor mechanism of the blood vessels was the basic cause for the changes observed.

Thus far, investigations had shown that frequently repeated injection of adrenalin or multiple adrenal grafts produced hyperplasia and degeneration in the blood vessels. These changes can also be elicited by irritation of the sympathetic nerve supply to blood vessels or by section of specially selected sympathetic filaments. The earliest phase of this cell reaction is one of hyperplasia affecting the smooth muscle cells of the media, followed by increase of the elastic fibers and proliferation of the intimal endothelium.

The next stage in the solution of the problem is the study of experimentally produced hypertension in animals. Three main types of procedure may be considered: First, hypertension can be created by operative measures affecting the renal circulation, either by clamping the renal arteries with Goldblatt's clamp or ligation of some of the vessels in the renal pedicle. Again it can be produced by bilateral subtotal nephrectomy. All of these methods produce a swift rise of blood pressure which is sustained and not paroxysmal in type, and after the initial gain there is a steady increase of the hypertension and deteriora-

tion of the animal. Second, operative intervention upon the carotid sinus with the division of the vasodepressor nerves will also produce a sustained rise of blood pressure. Third, hypertension may be produced by the injection of substances such as Kaolin into the cisterna magna.

The greatest interest and controversy has ranged around the first experimental method, the renal ischemic hypertension. Evidence for and against the adrenal glands playing a rôle in its production has been advanced by several American teams of research workers. Long ago, Tigerstedt and Bergmann isolated from the renal parenchyma a vasopressor substance which they called Renin. It had affinities to adrenalin and recent work has shown that renin and another vasopressor substance physiologically allied to it are both formed by the renal tissue, especially when this has been damaged through alteration of its blood supply.

Goldblatt has proved that if the condition of renal hypertension is produced by his arterial clamp it does not develop if bilateral adrenalectomy has been performed, despite the fact that the animals are kept in good condition by the administration of salts and a non-pressor cortical extract. This observation has been confirmed by some and denied by others. Collins and Wood found that experimental renal hypertension developed even when the kidney was isolated, showing that the nerve supply of the organ was not concerned in the production of the phenomenon. They found that unilateral adrenalectomy after the production of Goldblatt ischemia, produced a fall in blood pressure and if the other adrenal was excised there was a still further fall of the blood pressure, despite a still further constriction of the renal vessels. If, on the other hand, adrenalectomy was carried out as the primary procedure and followed by the production of renal ischemia, the blood pressure was found to increase but the rise was not well maintained.

In 1939, Diaz and Levy produced hypertension in rats by a subtotal resection of five-sixths of each kidney in two stages Twenty-three animals survived the operations and all showed a progressive rise of pressure from 110/60 at the outset to 235/150 at the end of ninety-four days. They carried out bilateral adrenalectomy and after an interval of two to seven days, the blood pressure of these animals fell 67 mm. Hg. and later a further 54 mm. Hg. but remained higher than before the partial nephrectomies. Histologically, the kidneys showed focal tubular damage and glomerulonephritis, while the adrenals presented evidence of *medullary hyperplasia*. A vacuolytic zone had developed between the cortex and the medulla and the former was relatively thin.

It is of great interest to compare the results of these investigations with those of Introzzi of Buenos Aires, published in 1938. He produced renal ischemic hypertension in a series of dogs and found that the control group all developed a progressive rise of blood pressure with retinal changes.

In another series, he divided the sympathetic innervation to both adrenals, prior to clamping the renal artery. In this group all the animals developed renal hypertension, despite the sympathectomies. In a third group, after having carried out the renal procedure, he resected half one adrenal gland and in addition performed lumbar ganglionectomy and division of the splanchnic nerves on the same side. In one series of experiments, these operations were performed on both sides. In those animals in which the bilateral procedure had been performed, the renal hypertension was completely counteracted, blood pressure fell to normal or nearly normal levels. On the other hand, unilateral subtotal adrenalectomy, combined with sympathectomy, caused only a slight fall in blood pressure from the hypertensive level and that only transitory.

Introzzi concluded that the hypertension produced by substances in the damaged kidney was dependent on adrenal integrity

and the production of sufficient adrenalin to maintain the blood vessels in a responsive state. His further work has shown that experiments on animals with hypertension from renal ischemia must be made while the hypertension is constant and moderate. If the arterial obstruction of the kidney is too great, renal insufficiency vitiates the results.

The failure of sympathectomy to relieve experimental hypertension in dogs has been demonstrated by the work of Alpert, Alving and Grimson who divided the right and left splanchnics and resected the four lower dorsal ganglia and obtained only a temporary decline of blood pressure. In America, Page has also confirmed that bilateral adrenalectomy after the production of renal ischemia, causes a fairly rapid subsidence of the hypertension, even despite the fact the animals can be maintained in condition by the daily administration of cortical extract and salts. Furthermore, if the bilateral resection of the adrenals is performed before the application of the renal clamps, no rise of blood pressure occurs. On the other hand, if the adrenal medulae are carefully destroyed, leaving the cortices functionally intact, the development of hypertension from the application of the Goldblatt clamps ensues without difficulty.

More recently, Friedmann, Somkim and Oppenheimer found that the concentration of renin in the kidneys of cats was not reduced ·by adrenalectomy. They also confirmed Page's observation that bilateral adrenalectomy gradually reduced the response to vasopressor substances such as renin and this sensitivity was only partially restored by administration of cortical hormones. They concluded that the renin of Tigerstedt is the cause of hypertension following renal injury and that its action is directly related to some substance excreted by the adrenal cortex.

The Second Method for the production of· experimental hypertension consists in the division, in rabbits, of the cardio-aortic nerves as close as possible to the thoracic cage, with suture of their central ends into the sternomastoid muscles. This is combined with division of the nerve fibers between the superior cervical ganglia and the carotid arteries with ligation and division of the interna. After fourteen days the blood pressure rises from 140 to 200 mm. Hg. Hypertension was investigated on these lines by Introzzi, and Leriche, Fontaine and Froehlich.

They found that unilateral adrenalectomy had no effect upon this type of hypertension while a resection of a moiety of the remaining adrenal caused a drop in blood pressure from .210 to 140 in one animal and in another from 220 to 100, but after twenty-seven days the pressure always returned to the previous high level. Further work of Fontaine confirmed this. It should be noted that these investigators left a fraction of adrenal tissue, which was not done in the case of the American workers. Further, it is well known that sympathetic denervation· is followed by increased sensitivity to adrenergic substances circulating in the blood stream. This factor combined with a portion of normally functioning adrenal would account for the failure to maintain the fall of blood pressure.

Thirdly, experimental hypertension produced by the intracisternal injection of kaolin has been studied by Jeffers, Lindauer and Lukern. If hypertension is produced by this means, bilateral denervation of the adrenals is without effect, but bilateral adrenalectomy is followed by a definite hypotensive phase. If cortical extract is administered, there is a return to the previous hypertensive level.

In view of the fact that a non-pressor extract of the adrenal cortex plus salts is sufficient for this recovery to take place, these workers concluded that the adrenal cortex is the essential portion of the gland for the development of experimental hypertension.

These lines of investigation have shown that the following factors are operative in connection with the hypertensive state:

(1) A vasopressor substance excreted by the renal parenchyma, which is allied to adrenalin, appears to be capable of producing hypertension only in the presence of another factor dependent on the cells of the adrenal cortex. This latter substance appears to be associated with the maintenance of the normal sensitivity of the peripheral vasomotor apparatus to adrenergic substances. Thus the removal of the adrenal cortex causes a gradual failure of the renin response due to a progressive threshold change in the cells of the blood vessels. Therefore, bilateral adrenalectomy counteracts renal ischemic hypertension, but bilateral destruction of the adrenal medullae permits the development of this condition. (2) The removal of the nerve supply to the adrenal bodies does not materially effect any of the types of hypertension experimentally produced, beyond a transitory fall.

At this stage, it is important to emphasize the caution so often advanced by Leriche, that all these forms of hypertension produced in the laboratory animal are foreign to the essential hypertensions in the human subject. They provide us with only a clue to the relationship between the adrenals, the kidneys and the sympathetic innervation, but the difference between the experimental conditions and the clinical entity must be kept in mind.

Pressor substances could not be demonstrated in increased amounts in the blood of hypertensive patients and the dictum was laid down by some physiologists that under no circumstances was surgical intervention on the adrenals justifiable, there being no evidence to link hypertension with the increased production of a hormone of the adrenalin type. However, Leriche assayed the adrenalin content of the suprarenal glands which he had excised from cases of essential hypertension and found that they contained a much greater quantity of adrenalin than the normal gland. More recently it has been shown that the pheochromocytomas are asso-

ciated with epinephrine crises, accompanied by paroxysmal hypertension. In these cases the tumors yield a very high adrenalin content. Moreover, the slightest manipulation of the tumors during operation produces a rapid rise of blood pressure, or conversely a dramatic fall on ligation of the adrenal blood vessels.

It is in this connection we must bear in mind the chemical transmission of the sympathetic nerve impulse both through the ganglionic synapses from the preganglionic fibers to the ganglion cells and from the post-ganglionic fibers to the effector apparatus at their distal extremities. The liberation of acetylcholine in the ganglia and an adrenalin-like substance around the effector terminals consequent upon the passage of the nerve impulse provides us with a chemical process linking up the peripheral reactions associated with paroxysmal hypertension with the increased adrenalin content of the suprarenal glands in those cases which exhibit hypertensive symptoms.

Lastly, in association with the experimental aspects of hypertension, we must recall the important work of N. K. Koltsov and M. L. Rochlin, in Moscow, upon the rôle of ions and hormones in the process of stimulation of effector organs. These investigators demonstrated that ionizable salt solutions have a direct synergic action on the effector mechanism of isolated blood vessels. Rochlin inferred that the response was due to a change of ionic concentration resulting in alteration of surface tension at the cell membrane. The cortex of the adrenal bodies has been shown to be intimately concerned in the metabolism of salts, the removal of the adrenals rendering imperative for life the administration of salts such as sodium chloride and sodium citrate. Therefore, abnormal action of the adrenals might lead not only to the increased production of adrenalin and of cortical substances complimentary for the pressor reaction of renin but in addition excite a disturbance

of the salt balance leading to increased sensitivity of the effector organs in the blood vessels to certain ionizable salts.

These influences would affect the vascular system in two ways: First, they would stimulate the local ganglionic network of the autonomic system in the wall of the vascular tube and, second, the sympathetic connections with the central nervous system. In the latter association we must not lose sight of the fact that both cholinergic and adrenergic phenomena are associated with the passage of the sympathetic nerve impulse from the central nervous system to the periphery and that adrenalin in high dilution shows reversible action.

Thus in cases of imbalance of the adreno-sympathetic apparatus we have a mechanism which once disrupted must lead directly to physiochemical changes in and around the cells of the effector mechanism in the media of the blood vessels. This in turn initiates a series of tissue changes which have been shown to follow chronic irritation of post-ganglionic sympathetic fibers or to hyperadrenalism, changes which in their early phase of muscle cell hyperplasia might lead to greatly increased sensitivity to pressor stimuli and therefore excessive physiological response. The fragmentation of elastica, intimal proliferation and degeneration of the media would lead to the development later of a fixed peripheral resistance and permanent hypertension.

In other words, in its earliest stages, hypertension associated with an adrenal factor would be intermittent, but later, vascular tissue change would produce permanent fixity of peripheral resistance with consequent persistent and progressive rise of blood pressure with the progress of the lesion.

A consideration of the renal factor connected with experimental ischemia of the kidneys must be deferred until the evidence of the clinical aspect has been discussed.

CLINICAL SYNDROME IN ESSENTIAL HYPERTENSION AND THE MECHANISM INVOLVED

The literature from many countries provides adequate materials to form a judgment on the different clinical types presented by the hypertensive syndrome.

American surgeons, such as Adson, Craig and deCourcy, have had the advantage of operating on a large number of these patients. Craig, in 1937, classified the hypertensions into two groups, primary and secondary, and with regard to the first named he mentions four types: (1) Those in whom the rise of blood pressure is slight and returns to normal on resting. In these cases the retinal vessels show slight sclerosis. (2) Moderate hypertension with moderate sclerosis; (3) severe hypertension accompanied by angiospastic retinitis; and (4) severe hypertension with edema of the optic discs.

This classification, based on the degree of clinical severity, is not sufficiently comprehensive to cover the fundamental differences shown in a large series of cases of primary hypertension. The outstanding types are: (1) Those cases in which the clinical course is characterised by paroxysmal crises associated with great rise of blood pressure from a base slightly or moderately above the normal level. This type may be associated with tumor formation in the adrenal gland, such as the pheochromocytomas, or may occur in the absence of neoplastic pathology. (2) Cases in which there is sustained hypertension gradually rising to higher levels. In this type, progressive cardiovascular changes are always found and therefore the graded retinal signs which form the basis of Craig's classification also occur. Type two is invariably connected with tissue change in the renal blood vessels. It may be termed the *Plateau Type* of hypertension. (3) The third type of primary hypertension is one in which the paroxysmal crises are superimposed on steadily progressive hypertension of the plateau type.

This classification is no mere segregation of clinical material on empirical lines according to signs and symptoms, but is dependent on a basic difference in the physiopathological mechanism involved.

The paroxysmal hypertensions forming Type One will be first discussed.

Before considering the mechanism underlying the clinical syndrome in cases of this type, I will give the details of a case which came under my own care, which demonstrates certain basic principles relative to the mechanism involved:

A woman, aged forty-seven in 1938, was referred to me by Dr. Unger of Blackpool, in June of that year. She had a history of paroxysmal·hypertensive crises extending over a period of fourteen years, gradually increasing in severity while recurring at shorter intervals The attacks were characterized by the following signs and symptoms: Pain felt over the left thorax spreading to the axilla and inner side of the left arm; severe palpitation, the pulse rate rising to 200 per minute; pain radiating from the left side of the forehead and gradually involving the whole head; profuse sweating, particularly of the palms of the hands and the trunk; nausea and retching and occasionally vomiting and rise of blood pressure from 130/80 to 182/90. Between the attacks she showed signs of great muscular weakness, each attack leaving her increasingly exhausted, to such an extent that she had to be helped when moving from a chair or walking a short distance. There was nearly constant precordial pain, stiffness of the muscles of the back and neck, and dull frontal headache, persisting from one crisis to another. These attacks came on almost daily, occurring chiefly on rising from bed or in attempting to walk, and lasted from a few minutes to some hours. The slightest effort produced a rise in pulse rate of 30 or more per minute.

On examination there was no sign of cardiac enlargement; heart sounds were loud and bumping; there were no murmurs; the pulse was of very small volume, owing to the marked contraction of the radial arteries.

No abnormal changes were visible in the fundi; lungs and central nervous system were normal. The urine showed the presence of albumen and was cloudy; there was no sugar present. The thyroid was not enlarged and there were no signs of exophthalmos. There was no hepatic or splenic enlargement in the abdomen but slight tenderness over the left costovertebral angle. The hands and feet were cold, clammy and slightly bluish. The muscles were atrophic. The blood count showed hemoglobin 90 per cent; red cells 5.0; color index 0.9; white cells 4.0; no abnormal forms were present.

An excretory pyelogram showed no abnormality of the kidneys. X-ray of the lung fields showed no clinical evidence of pulmonary disorder. The electrocardiogram showed a simple tachycardia. The basal metabolic rate was plus 2 per cent; blood urea 22 mg. per cent; blood calcium 11.6 mg. per cent; blood chlorides 450 mg. per cent. The Wassermann reaction was negative.

Dr. Unger saw her again on August 28, 1938, and gave her an injection of 10 mm. of adrenalin in two equal doses at an interval of about eight minutes. The pulse rate before the first injection was 76, the blood pressure 135/80. The patient took the injections without the slightest upset and during the next seven minutes had no untoward symptoms. After the second dose she continued talking calmly for a minute or two, then showed sudden signs of unrest and called out that an attack was coming on. The pulse rate was now 146, the radial arteries contracted, the heart beating violently with forcible contractions. The blood pressure rose to 190/90 with visible blanching of her cheeks. There was considerable pain and throbbing in the chest and head. The reaction continued for about twenty minutes and gradually subsided. The patient was very exhausted. She then suddenly complained of intense occipital headache and forty minutes after the first injection shouted out that she had a severe pain in her back which was accompanied by contraction of the spinal muscles and acute tenderness over the costovertebral angle on the left side.

A blood sugar taken before the adrenalin injection was 100 mg. per cent and an hour afterwards had risen to 177 mg. per cent. The blood pressure was now 140/80 and the pulse rate 112.

I carried out a left adrenalectomy on September 18, 1938, excising a gland weighing 4.1 Gm. which showed no abnormal histological feature. After an uneventful con-

valescence the patient was discharged home on October 28, 1938, since which date to the present time (over six years later) she has had no repetition of the hypertensive crises. Her blood pressure has remained more or less constant at 145/90. Following her operation she steadily regained weight and strength and has been able to live a normal life.

It will be noticed that the paroxysmal attacks in this patient could be excited by the injection of adrenalin. In this respect, as well as in the clinical syndrome, a close comparison may be made with a case of paroxysmal visceral crises which I investigated some years ago.

The subject was a tabetic who had undergone posterior rhizotomy by the late Sir William Thorburn. Injection of adrenalin produced violent crises accompanied by hypertension, tachycardia, sweating and rigidity of the spinal muscles, all of which symptoms were relieved by nitrites.

Investigation of the nature of the afferent sensory pathway in cases of hypertensive crises associated with tabes showed that extensive posterior root section left a vague deep sensitivity of the muscles within the area of cutaneous anesthesia. Similar observations were made by Walter Lehmann, of Göttingen, Föester, at Brëslau, and others. It was noticed that the lightning pains were cured by posterior radiocotomies, whereas on the other hand, persistence of deep sensation was associated with a recurrence of crises in which pain of a griping character was referred by the patient as being felt deep within the abdomen. Tabetic crises treated by both anterior and posterior root section were free from these recurrent symptoms. It was suggested that pain crises of this type are due to irritation of the sympathetic fibers and the sensory phenomena are dependent upon axons traversing the anterior spinal roots and associated with the end organs of Agdhr in the striated muscles. A series of experiments were carried out on animals which appeared to confirm this view.

If paroxysmal hypertensive crises are due to sympathetic imbalance, it follows that there is either an excessive production of vasopressor substances or there is a change in the threshold required to elicit normal responses in the vasomotor apparatus within the walls of the peripheral vessels, or both factors are concurrent. In this association, the cold pressor test is of great importance; if the hand is immersed in ice-cold water at 4°c. for a few minutes, the blood pressure is found to rise rapidly to a high level in the true hypertensive case, but the response in the normal person is always of a low grade, showing that there is an increased susceptibility of the vasopressor mechanism to surface stimuli in the hypertensive individual. A series of experiments on variations of the pressure-pain threshold in the human subject throw some light in connection with this problem.

I found that moderately strong Faradic stimulation of a mixed peripheral nerve such as the median, produced a fall in the threshold for pressure pain and this appeared to affect the cutaneous receptors more than those of the deep tissues, and it was found to occur independently of vascular change, proving that physiological change around the receptor occasioned by the electrical stimulus altered the threshold for the perception of pressure pain. Moreover, in those experiments in which the peripheral circulation was released, this degree of electrical stimulus was accompanied by sweating and vasoconstriction. It is suggested that in the paroxysmal hypertensions there is a cyclical lowering of the threshold values such that stimuli of a lower degree excite pressor responses and the reaction to stimuli of normal quality is so exaggerated that a critical phase results. The constant repetition of such phases may result in the facilitation and induction of the synaptic junctions involved.

The work of Youmans and his collaborators at [Portland, Oregon, has demonstrated the biochemical processes involved

in these rapid clinical reactions. They have shown that the injection of acetylcholine is followed by a reflex liberation of adrenergic substances. This occurs within a few seconds of the injection of acetylocholine and originates both from the adrenals and from the adrenergic nerve endings, because the isolated intestine of the de-medullated animal still shows the inhibitory phase of adrenergic excitation. That it comes from the adrenergic sympathetic endings was shown by the absence of intestinal inhibition after removal of the celiac ganglia. Such initial vasodepressor action might be due either to aberrant stimuli from the higher centers of the central nervous system or to biochemical imbalance, and this is followed instantly by the reflex liberation of adrenalin from the adrenalin medullae and the adrenergic endings of the sympathetic. The latter with their associated motor mechanism have either an abnormally low threshold produced by biochemical change or inherited tendency, which results in a rapid critical response to the chemical reflex and excites the full clinical syndrome which we classify as paroxymal hypertension.

The lowering of the threshold for stimuli productive of vasomotor contraction is also shown by the observation that the pheochromocytomas of the adrenal glands, proved to contain a large quantity of adrenalin, may, or may not, be attended by crises of paroxysmal hypertension, showing that an additional factor must be present besides the increased quantity of adrenalin, which determines the recurrent critical phenomena. Such a factor may well be linked with the depressor substance acetylcholine and the adrenergic reflex.

The *Second Type of Primary Hypertension*, the *plateau variety*, is characterized by a rise of blood pressure which is steadily maintained at a high level and tends to show a progressive rise as the physical position deteriorates. This variety occurs in two distinct groups: (1) The largest group is common to the fourth and fifth decades of life and often associated with the menopause in women. (2) A very small and clinically select proportion is associated with chronic atrophic pyelonephritis and may arise early in life.

The common type, linked with menopausal changes, may be due, as suggested by de Courcy, to the failure of the balance in the metabolism of fibrous tissue. The activity of the adrenals at a period of life when the gonads decay, results in a replacement of tensile tissue such as muscle and elastica by fibrotic depositions. These cases are related to the tissue changes within the walls of the blood vessels. A pathological process similar to that evoked by sympathetic nerve irritation might give rise to disorganization of the vascular supply to the renal tissue, resulting in damage to the cells of the renal parenchyma and would be followed by the liberation of renin and the initiation of the renal type of hypertension.

Page believes that renin is released by the kidneys when their pulse pressure is reduced. Renin is thought to combine with a pseudoglobulin in the blood to form angiotonin which has been isolated and identified as a pressor substance producing hypertension by its action on the arteries. Other investigators consider that renin is an enzyme which acts on its globulin substrate to form a pressor substance Hypertensin identified with Angiotonin, the whole process being counteracted through another enzyme Hypertensinase which breaks down the pressor combination in the blood and tissues. These substances produce their vasoconstrictor action only in the presence of some complementary factor excreted by the cortex of the adrenal gland.

Another theory advanced by Holtz to explain the renal hypertensions, suggests that the kidneys contain the enzymes decarboxylase and amine oxidase, and the latter acts only in the presence of oxygen. During ischemia, the oxygen supply is reduced and whilst decarboxyla-

tion of amino acides continues, deamination is incomplete, therefore amines form, many of which are pressor in action, especially the phenolic compounds, and these in the presence of a labile vasomotor apparatus due to adrenal activity, produce the hypertensive syndrome.

Many of these cases of hypertension are associated with hyperplastic changes in the adrenal glands resulting in a vicious circle, productive of vasopressor substances.

Clinically, all these cases of plateau hypertension show progressive physical degeneration with the gradual retinal changes mentioned by Craig. In consequence of tissue change in the blood vessels being a basic factor of their pathology, there is progressive cardiovascular and renal disturbance toward complete failure and death.

The second and smaller group of the plateau hypertensions is associated with chronic atrophic pyelonephritis. The incidence of this type of hypertension may be judged from the observation of facts reported by William F. Braasch at the Mayo Clinic. Here 4,000 cases of hypertension were seen in one year. Of this number, only 100 or 2.5 per cent presented non-nephritic renal lesions and of these, merely nineteen or .5 per cent were selected for operative treatment; in the remaining eighty-one cases, the renal lesion appeared to be co-incident and not related to the hypertension. Thus, of this large series of cases, only a fraction of 1 per cent were suitable for surgical treatment by nephrectomy.

Further research work has shown that hypertension occurred in 20.3 per cent of 793 cases of renal stone, but perinephritis was not associated with hypertension.

The problem arises as to why only a small percentage of cases out of a large series all showing essentially the same type of damage to the kidney substance, develop the hypertensive syndrome. Comparison is suggested with the incidence of paroxysmal hypertension in the pheochromocytomas. Once again a further factor

toward the initiation of the pressor response is indicated and in this case the change probably concerns the adrenal cortices and therefore the subtotal resection of the adrenal glands and in some cases a unilateral adrenalectomy is as efficacious in reducing the hypertension as the resection of a kidney showing changes of chronic atrophic pyelonephritis.

The Third Clinical Group presented by the Primary Hypertensions is one in which the features of the two preceding types are combined. These cases show a sustained hypertension with paroxysmal attacks superimposed. The latter are often the earliest feature in the development of the condition, while only gradually is the general level of the blood pressure fixed at higher values between the crises until ultimately the fully developed plateau hypertension ensues with the progressive cardiovascular degenerative changes. It is a surprising fact that many of the paroxysmal cases remain free of all signs of sustained hypertension over periods amounting to years, as in the case I have recorded in this paper, while in other instances Type 1 merges with Type 2 after a relatively short interval. The clinical pitfalls in this type are exemplified by the following case under my care:

An asylum attendant, aged thirty, was admitted to my wards complaining of severe griping abdominal pain referred to the left flank and transumbilical regions. There was a history of complete constipation with bowel action at intervals of seven days or more; there was slight distention of the abdomen and attacks of vomiting. Urine excretion was normal. The patient was pale and sweating from pain. In view of a previous appendicectomy scar and the critical nature of his symptoms, a laparotomy was carried out on the mistaken diagnosis of a possible intestinal obstruction. No abnormality was found within the abdominal cavity. The patient died within forty-eight hours from a dramatically sudden epinephrine crisis with a blood pressure of over 300. Postmortem examination showed hypertrophy of the medullae and cortices of both adrenal glands with marked cardiovascular and renal

changes. In this young man's case there was evidence from his doctor that he had suffered from what we know to have been hypertensive crises accompanied by vomiting and abdominal pain for two or three years prior to his death, with marked over-action of the sympathetic, producing intestinal inhibition. The advanced cardiac changes could be associated only with long-standing and persistent hypertension.

The physiopathological mechanism of this third clinical group is clearly indicated from the findings in this case, both factors renal and adrenal are operative and in the latter instance the cortex and medulla of each gland contributed their quota to the production of the symptom complex. The renal changes result in renin liberation which in the presence of substances produced by the adrenal cortices caused the sustained pressor response whilst the paroxysmal crises followed on hyperadrenalin excretion by the hypertrophied adrenal medullae in combination possible with a nerve factor associated with the liberation of acetylcholine. It is interesting to find that this man had shown marked pyschological depression during the last two or three years preceding his final illness.

RELIEF OF HYPERTENSION BY SURGICAL MEASURES

The surgical relief of the several types of hypertension must be considered in relation to each of these.

Paroxysmal Hypertensions. In this group, associated with or without the presence of neoplasm of the adrenal glands, the question of surgical relief must be considered. In those cases in which a pheochromocytoma has been diagnosed, such intervention is imperative; but for all those cases not connected with tumor development, in which medical measures have failed to give relief, surgery has an undoubted place in the treatment. The uninterrupted clinical course of this disease shows progressive physical deterioration in the patient, leading to total social incapacity, and from permanent renal and cardiovascular damage, to early death.

The reports on the operative results on hypertension attained by surgeons of many different countries, show quite definitely that all the symptoms associated with the critical phase can be relieved by operative treatment. The palpitation, heart-consciousness, headaches, thoracic and spinal pains, sweating, tinnitus and physical exhaustion are relieved by surgical procedure, despite the fact that in many cases the blood pressure is not restored to normal levels. This is a most important practical point which has lead to much confusion in assessing the results of surgery. Some workers in reporting their cases are dominated with the sole conception that the hypertension is alone the necessary factor for elimination. Leriche has many times stressed the point that the material improvement from the patient's standpoint is centered around the abolition of the whole symptom complex which cannot be measured in millimeters of mercury. The latter is only one side of the complicated sequence of events and a very moderate subsidence of the hypertension may be accompanied by really dramatic relief to the patient from the whole train of symptoms. In attacking the paroxysmal hypertensions by surgery, we have three general lines of precedure: (1) Denervation of one or both adrenal glands; (2) resection of one adrenal or subtotal resection of both adrenals, and (3) denervation combined with subtotal resection.

Before citing the results of surgery in these several methods, we must recall certain factors which are of the utmost importance in connection with the line of surgical approach. In the first place division of the post-ganglionic fibers or removal of the paraspinal ganglia from which they arise, leads to a progressive lowering of the threshold in the peripheral vascular receptors to circulating adrenergic substances, so much so that the animal sensitized by sympathecomy forms the best method of testing for the presence of such hormonal substances. This sensitivity gradually appears after sympathectomy, attaining a maximum development about a month following the operation and may persist indefinitely.

In the second place, division of the pre-ganglionic sympathetic fibers, although it leads to a similar sensitization of the distal vascular mechanism, does not produce anything like similar degree of hypersensitisation. The position of the cells of the adrenal medulla, since they are derived from the embryonic ganglionic crest like those of the sympathetic ganglia, is one of similar relationship to these ganglion cells, that is to say, the nerve fibers reaching the adrenal medulla via the splanchnics in the thoracolumbar outflow from the sixth dorsal to the second lumbar roots, are pre-ganglionic fibers. Divisions of the splanchnic will thus be a division of pre-ganglionic fibers so far as the adrenal medullae are concerned, but on the other hand there are many other fibers passing through the splanchnics to a peripheral distribution that have already come from cell stations in the paraspinal ganglia near the origin of these nerves. Division of such axons will consequently produce similar results to the section of post-ganglionic sympathetic fibers.

Bearing these observations in mind, we may turn to practical results of surgery. Adson and his collaborators in America, first carried out very extensive ventral rhizotomies of all the roots from the sixth dorsal to the second lumbar on both sides. Adson reported excellent results. Unfortunately the hypertensions so treated were of mixed types but he stresses the fact that this procedure abolished the hypertensive crises with the accompanying cardiac consciousness, precordial pain, cephalgia, spasm of the retinal arteries, while the cold pressor test showed a lower level of reaction and papilledema subsided. There was also a curious water lag during the day followed by polyuria during the night after the operation.

The severity of the operation can be judged by the number of roots that would have to be exposed and therefore Adson and Craig altered their technic to a bilateral division of the splanchnic nerves below the diaphragm, combined with section of the white rami of the first and second lumbar nerves. By this method they obtained equally good results comparable with those obtained from extensive root section and they stressed the fact that the best results are those in patients below the age of forty.

As regards the hypertension itself, they record falls of systolic pressure immediately after operation from 270 to 100 and of diastolic pressure from 170 to 60. The pressures tend to rise slowly during the patient's convalescence until average pressures of 160 to 120 systolic and 110 to 90 diastolic are attained a month or so after the denervation, but as in the patients treated by rhizotomy, all the critical symptoms subside.

The future history of these cases shows degrees of instability. In some patients certain symptoms return after a year or two, but there is no doubt that permanent benefit is achieved by the bilateral operation. There are certain complications. There is a failure of ejaculation leading to sterility in the male, although there does not appear to be any interference with micturition or defecation; nor in the female is there any interference with menstruation or pregnancy.

This method of treatment may fail in some cases on account of the sensitization of the peripheral receptor apparatus to adrenergic substances in the blood stream and therefore the second line of attack by removal of the adrenal gland on one side, or bilateral subtotal resection must be considered.

Oppel who had experience of large numbers of cases of juvenile arteritis and arterial crises attributed their pathological cause to adrenal dysfunction consequent upon great stress and strain during the period of the Russian revolution, when such cases became exceptionally common. He treated many patients by adrenalectomy and although at the time some workers did not credit his results, subsequent investigation has shown that he obtained a very high measure of success, often among very poor circumstances. The

practice of adrenalectomy for paroxysmal hypertension has proved that the unilateral operation will completely abolish the critical syndrome and I have mentioned a case in which there has not been a single recurrence of the symptom complex from the time of operation over six years ago. Unilateral adrenalectomy cannot obtain its results by the simple abolition of an excessive secretion of adrenalin *per se*, because we must presume equally good function in the remaining gland. Its effect must be exerted upon the threshold level for stimuli in the peripheral vasomotor apparatus of the blood vessels. In the case I have recorded there was no histological abnormality of the gland, and Leriche and his school have particularly stressed this point that some of the glands excised show no pathological changes and yet the clinical condition of the patient is cured or very greatly relieved.

Unilateral resection of the adrenal also avoids the danger of sensitization of the peripheral effectors that we have seen to follow post-ganglionic sympathectomy and also there is an absence of the urogenital complications.

Bilateral subtotal resection of the adrenal glands is an operation that may introduce a dangerous complicating factor. In the first place it is difficult to be sure that the functioning tissue left has not been damaged, either by ligation of vessels or from secondary edema accompanying traumatic reaction, and secondly, insufficient tissue may be resected. A number of cases have been reported in which death from adrenal failure has followed this method, and therefore the third procedure, a combination of adrenalectomy and sympathetic denervation would seem preferable. This procedure should be undertaken in two stages, which permits the surgeon to estimate the degree of improvement before submitting the patient to the further surgical risk of operation upon the remaining gland. The primary procedure should be one of unilateral adrenalectomy without splanchnic division. In the majority of

paroxysmal cases the operation is sufficient; but if there is a relapse of certain symptoms, the sympathetic denervation of the remaining gland may be carried out after an interval of at least several months in order to permit the patient to stabilize following the first operation. In connection with the second procedure, it must be borne in mind that cases have been reported of sudden necrosis of the gland following denervation, although operative trauma may have something to do with them.

The surgical treatment of those patients who exhibit the plateau type of hypertension falls naturally under two procedures: (1) Nephrectomy for the small group of cases in which the lesion is directly connected with the presence of a unilateral chronic atrophic pyelonephritic kidney and (2) adrenalectomy, where there is no evidence of a primary renal lesion associated with the hypertension.

The operative results of nephrectomy for hypertension following chronic atrophic pyelonephritis show complete relief in 70 per cent of the cases, but as previously mentioned, the incidence of this particular type is a mere fraction of the number of cases presenting symptoms of essential hypertension. At the Mayo Clinic during a period of ten years, only forty-three cases of atrophic pyelonephritis were subjected to nephrectomy.

With regard to adrenalectomy in cases of severe malignant hypertension, Eisenberg carried out subtotal adrenalectomy for severe cases of this type. There were two deaths and those that survived showed equivocal results. Craig has emphasized the point that those patients who show cardiovascular damage are no subjects for surgical treatment of hypertension.

Apart from cases showing advanced deterioration, a number of cases in the fifth and sixth decades of life have been subjected either to bilateral sympatic denervation of the adrenals or to bilateral subtotal adrenalectomy with the very marked improvement of their symptoms. Even unilateral resection has been followed

by good results. In a woman of thirty-five years, showing a sustained hypertension of 120–220 and constant pain over the left renal region, I carried out a left adrenalectomy with a subsequent fall of pressure to 80–120 and complete relief of the pain syndrome since the operation over a year ago.

For these cases of sustained hypertension, bilateral subtotal resection of the adrenals would seem to be the more justifiable procedure on the experimental basis, and one which, in the hand of the American surgeons has given reasonably good results. As compared with sympathectomy of the adrenals the practical observations of Galata are of special interest. He operated on sixteen patients with primary hypertension by the lumbar route, carrying out subtotal adrenalectomy. Of this series, three were completely cured, eleven very considerably improved and two slightly improved. The systolic pressure generally dropped by 60 to 100 mm. Hg. and the subjective improvement was more remarkable still. On the other hand, of the seven patients treated by splanchnectomy, only one could be considered cured, three were slightly improved and three remained unchanged.

Results such as these are clearly to be anticipated in view of the renal-adrenal factor present in all plateau hypertensions; and where a paroxysmal feature is absent, the operative indications are strongly against adrenal sympathectomy.

The *Surgical Treatment* of the *Third Type of Hypertension* must take cognizance of the paramount importance of the critical element in this type of hypertension, for it is during these great rises of blood pressure, associated with all the phenomena of acute epinephrine shock, that death may ensue. We are faced with the danger of the development of these crises, especially during and immediately after operative trauma, and therefore we must be guided toward the minimum and most essential procedure. For this purpose, bilateral operation is quite definitely contraindicated at one sitting, and bilateral sympathectomy is a doubtful procedure. The obvious line of attack is the resection of one adrenal gland. The results of such an operation are well shown in a case reported by Delannoy, Warembourg and Demarez[3] in 1939. In a man aged fifty-six, suffering from plateau hypertension with violent paroxysmal crises, they performed left adrenalectomy. The crises ceased and the blood pressure fell from 320/160 to 180/140 and his general condition was markedly improved. Therefore, in these cases of Type 3 hypertension, the primary procedure should be a unilateral adrenalectomy and if, after an interval of months, there is an appreciable relapse, intervention on the remaining side should be considered. Goldzicher has shown that a quarter of one adrenal can maintain life, thus a subtotal resection of the remaining gland might encroach on the danger line of adrenal insufficiency. Surgery should, therefore, be restricted to splanchnectomy, but we must bear in mind that even this has been followed by adrenal failure.

CONCLUSIONS

Essential hypertension of the paroxysmal type and the symptom complex associated with it, is a condition directly connected with a disturbance of balance between the adrenal gland and the sympathetic mechanism in the walls of the blood vessels. The failure of the adrenals to maintain the normal condition of homeostasis within the body leads in some cases to critical phenomena in which the reflex chemical mechanism based on acetylcholine and the liberation of adrenergic substances plays a vital part, and to this may be linked hereditary and psychological elements.

The recurrence of such cycles of energy explosion sensitizes the whole adrenosympathetic mechanism, producing a lowering of the threshold to pressor stimuli, so that the crises increase in frequency and degree.

These critical phases often begin in the earlier decades of life and may be attacked surgically by either unilateral resection

of one adrenal or by bilateral subtotal adrenalectomy and bilateral splanchnectomy. The balance of evidence is in favor of adrenal gland section as being the more efficient procedure and one which does not lead to urogential complications and sensitization of the peripheral sympathetic. It has been shown that cures of long duration can be achieved by the relatively safe unilateral operation.

As regards the sustained or plateau type of hypertension, there is probably early damage to the renal blood vessels leading to fall of the renal pulse pressure and the formation of the renin type of pressor substances in the renal parenchyma. These in turn stimulate both cortical and medullary changes within the adrenal bodies, as well as producing hypertension themselves, in the presence of a cortical factor.

Thus, there is a vicious cycle which tends toward progressive deterioration from cardiovascular change. In order to break this cycle by surgical measures, bilateral subtotal resection of the adrenals would seem to be the most scientific method and one which, in the hands of different surgeons in various countries, has given a reasonable measure of symptomatic relief, provided cardiovascular damage is not too far advanced.

The best results seem to be obtained in patients under the age of fifty years, although some of the American surgeons mention forty years as the optimal age limit, but there may be some confusion with the paroxysmal type belonging to the earlier decades.

A small fraction of the cases pertaining to this category are directly associated with chronic atrophic pyelonephritis, and for these the correct procedure is nephrectomy which gives excellent results in 70 per cent of the cases.

Lastly, in the third type, in which the critical element is superimposed on the plateau type of hypertension, the adrenal factor is paramount and unilateral adrenalectomy clearly indicated as the primary operation. After a reasonable interval, provided that the symptom complex persists or deteriorates, a denervation of the remaining gland may be considered when the patient has stabilised.

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BRONCHIECTASIS AND ITS SURGICAL CONSIDERATIONS

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THE surgical treatment of bronchiectasis has passed through a number of evolutionary stages up to the present well established and accepted method of treatment, which is partial lung resection. In passing through the various stages and methods of treatment a good many factors have been learned regarding this particular disease, of the use of the various technics[1] of thoracotomy and pulmonary resection, and of pre- and postoperative thoracic physiology. Bronchiectasis is probably the one disease most suitable for and amenable to pulmonary resection. Not very many years ago, however, case fatality rates from resection were quite high, reaching 40 to 50 per cent or more. Recently the rate, as reported by experienced surgeons, has dropped as low as 3 per cent. Indications are that it will be reduced still further. The advent of the sulfonamide drugs and penicillin and their use pre- and postoperatively unquestionably play a very important part in avoiding postoperative pulmonary complications that were so frequent in these cases.

The natural course of bronchiectasis and its interruption by the procedure of lobectomy is still not thoroughly established in the minds of many physicians. At the risk of repeating what is already known some statistics and comparisons of medically and surgically treated cases will be given.[10,13,57,59,66] Perry and King[57] analyzed 400 cases treated at the Massachusetts General Hospital, between 1926 and 1938. Of these, 140 were treated surgically. In this number were included fourteen who had a thoracoplasty or the old exteriorization type of lobectomy. Of the non-surgical group 55 per cent had been traced by January, 1939, and found to be living while 26 per cent were known to be dead. Riggins[59] reviewing 100 cases reports the morbidity as: 25 per cent doing full time work, 40 per cent able to do part time work, and 35 per cent not able to work. Of the surgical cases in which the modern type of pneumonectomy or lobectomy was done, an operative fatality of 3.3 per cent was found. Of the entire group 109 were traced and only two were found to be dead. These figures are not exactly comparable but indicate a definite advantage to the surgical type of treatment. If in addition the complications[25,60,66] of bronchiectasis such as atypical and recurrent pneumonia, lung abscess, cor pulmonale, brain abscess, empyema, emphysema and amyloid disease are considered, together with the fact that patients are chronic invalids and thus subject to other diseases, the advisability of surgical interruption of the natural course of the disease is emphasized.

The above quoted statistics apply to a not so recent series of cases. The medical treatment of the disease of bronchiectasis and its underlying pathology of fibrosis, stenosis, recurrent infection, etc., has changed very little recently. However, the results and methods of surgical care have changed in recent years. With modern methods the previous statistics as to surgical results may be considerably improved.

Etiology. The etiology of bronchiectasis has been studied by a good many men.[3,26,40,46,60,70,71] There are some disease conditions that very definitely cause or lead to bronchiectasis. These are recurrent childhood pneumonias, complicated or severe cases of measles or pertussis, inflammatory strictures of the bronchi, tuberculosis with bronchial stenosis such as foreign bodies, adenomas and cancer. Other

theories as to the cause of bronchiectasis involve the possibility of congenital weakness of the bronchi or bronchial musculature, and chronic allergic bronchitis. The relationship between chronic sinus infection and bronchiectasis has been discussed repeatedly. The actual mechanism involved in the process of development of the bronchial dilatations is not entirely agreed upon. Kline[40] states that it is due to a defect in the muscular and elastic tissue of the wall of the bronchi. Robinson[61] states that it is due to an inflammatory destruction of the bronchial wall with subsequent fibrosis, and he suggests that the infection could be blood borne. Warner[70] says that the enlargement of the bronchi during inspiration is exaggerated in inflammation and leads to permanent changes. Andrus[3] believes that the changes are brought about by atelectasis plus the pull on the bronchi as a result of the changed intrathoracic pressure. McNeil, McGregor and Alexander[46] state that destruction of tissue and not dilation is the cause of the changes in the bronchi.

Incidence. It is difficult to determine the actual incidence of bronchiectasis in general because of the difficulty of an accurate diagnosis and the common disregard of a chronic cough, particularly if the chest x-ray is negative. Often these patients are not seen by the physician until some complication develops. The true diagnosis of a case is often made only after repeated complications have occurred and a thorough study is instituted. A good many cases are being seen in various clinics, particularily those for children and young adults.[22,42,46] Bronchiectasis appears to be a not infrequent cause of chest complaints in this and other age groups.[51,44]

In a recent chest survey[29] of 442,252 individuals, 4,982 non-tuberculous lesions were found and of these 252 or 0.057 per cent or 1 in 1800 were diagnosed as bronchiectasis. These figures are, of course, not accurate as a definite diagnosis can be made only by specialized diagnostic pro-

cedures using radio-opaque material. However, they are suggestive and may give some indication of the disease incidence.

Pathological Changes. The pathological changes[14,35,61,66,74] that are present when bronchiectasis has advanced to the point where it can be diagnosed clinically and by bronchograms must be considered to be irreversible for the most part. It is true that the removal of a foreign body or other bronchial obstruction may relieve the patient of many of his symptoms,[27] and that an adequate medical regimen may occasionally convert a "wet" to a "dry" bronchiectasis, but the pathological changes of dilatation and fibrosis remain. Whether the changes occur as a result of a pulling force, a dilating force, or a destructive process, the fact remains that there results a dilated, fairly rigidly walled, fibrosed structure which will not return to its original condition. The bronchial dilatations may take several forms, the two main types being the saccular and the cylindrical or tubular forms.

Diagnosis. The diagnosis[2,14,19,24,34,45,52,53,63] of bronchiectasis is so important for the successful treatment of the disease that we wish to mention the method we use. A bronchogram is absolutely necessary for a thorough diagnosis, and any discussion of methods is primarily concerned with technics of bronchial injection. The importance of a thorough study cannot be overemphasized, particularly at present when segmental resections of portions of lobes are being performed.[12] An incomplete injection may fail to reveal an anterior or posterior group of dilatations, involvement of the right middle lobe, or the lingula on the left. We do not believe that bronchoscopic catheterization of the various divisions, or the passage of catheters is necessary for the injection. A much simpler and equally satisfactory procedure is the instillation of warmed opaque media using the usual office syringe with a curved cannula or needle and with the patient leaning to one side, or the insertion of an 18 gauge needle through the cricothyroid

membrane under local anesthesia and the injection of the medium in this manner. It is necessary to inject only a small

ment in some instances. The actual incidence of this type of bronchiectasis is uncertain.
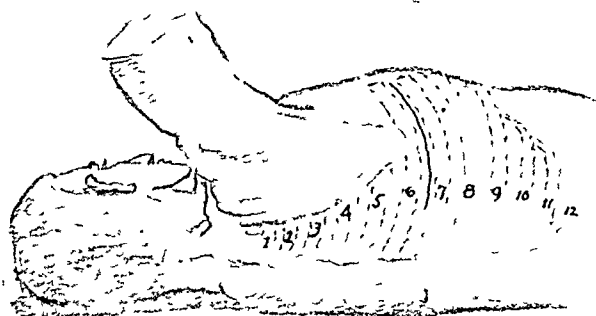
FIG. 1. Posterolateral incision.

amount of opaque media, 10 to 12 cc. being used for the injection of the lung on one side, or a total of 20 to 25 cc. for a complete injection of the lung on both sides. Following injection or during injections, if the needle through the cricothyroid membrane is used, various positionings can be employed to outline the several lobes and divisions of the bronchi.[2] These latter procedures cause the patient little or no discomfort.

A good many cases of bronchiectasis have undoubtedly been overlooked by all of us because of the hesitation in using lipiodol or some similar opaque media in these patients. This is particularly true in children. However, if one keeps in mind some of the clinical features of this condition, many unnecessary injections can be avoided. The history of recurring respiratory infections, the presence of a chronic productive cough, the presence of a fetid sputum increased by dependency and perhaps characteristically layered, hemoptysis and a secondary anemia are certainly suggestive of the condition. A good many other clinical signs may be present at times which will aid the diagnosis of bronchiectasis. For the future welfare of the patient, a diagnosis should not be missed as a result of our hesitation in using lipiodol.

A non-productive or "dry" type of bronchiectasis has been described. This is said to cause fewer symptoms and complications, and may need little or no treat-

Treatment. As previously mentioned the generally accepted method of treatment that is considered best at the present time is lobectomy.[15,16,18,29,31,39,42,56,57,68] However, this can be carried out with a justifiably low mortality only in cases with unilateral one lobe involvement (or one lobe and the middle lobe on the right, and the lower lobe and lingula on the left). Bradshaw and O'Neil[12] in reporting seventy-six cases stated that in twenty-four cases with one lobe involvement the mortality was 4.2 per cent, in twenty-six cases in which one lobe was removed but others involved the mortality was 15.4 per cent, in seventeen cases in which two lobes were removed the mortality was 18 per cent, and in nine cases in which pneumonectomy was done the mortality was 44 per cent. This, of course, must vary in different clinics. Many cases have been reported in which multi-lobe lobectomies and pneumonectomies for bronchiectasis have been done.[11,30,35,54,55,62]

The usual medical measures[64] can be used in those cases not suitable for surgery and in preparing other patients for surgery. These measures include dependent drainage,[49] bronchoscopic aspiration,[20,33,18,50] bronchial irrigations,[65] iodized oil[4,52,63] and sulfonamide injections[43] and vaccines. Recently penicillin solutions have been used as sprays and inhalations in an attempt to relieve the infection and drainage. We have used penicillin on several occa-

sions, but did not notice much improve-
ment. Bereck, in 1934, first advocated
x-ray treatment[55] in an attempt to convert

died. Timely surgery might have prevented
this.

We have been placing our recent cases
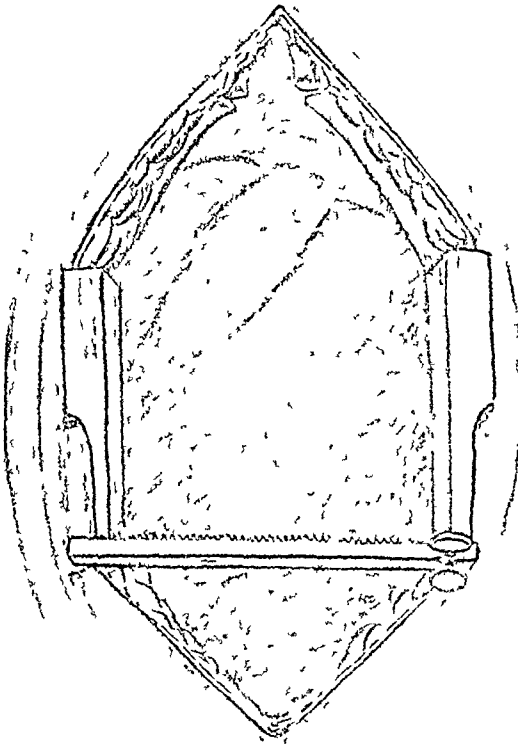
FIG. 2 Exposure of lobes of the lung, on the right.
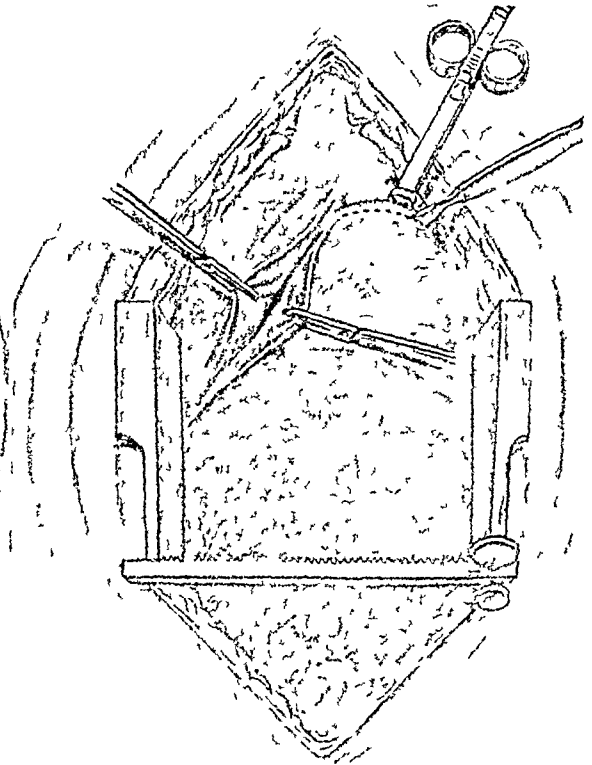
FIG 3. Removal of lower lobe (tourniquet in place).

a "wet" to a "dry" type of bronchiectasis.
It was also suggested that the x-ray stimu-
lated antibody formation and tissue resist-
ance. However, the result of treatment by
x-ray of different series of cases has shown
the results are not satisfactory. The elimi-
nation of foci of infection in the teeth,
tonsils and sinuses[32 72] and the correction
of any factors of malnutrition are standard
procedures prior to operation. In the pres-
ence of any recent flare-up of focal infection
a sufficient period should be permitted to
elapse prior to operation to insure a
thorough recovery of the patient. We are
not, however, in sympathy with the idea
of a period of three to six months' routine
observation before carrying out surgery. In
one of our cases the patient, a child twelve
years of age, after a period of about three
months returned to the hospital with
pneumonia from which he subsequently

on sulfadiazine or penicillin for several days
prior to operation and continuing the
administration of the drug for four to five
days postoperatively. Postural drainage is
used the morning before operation.

Our operative procedure has been car-
ried out under intratracheal anesthesia
using a closed method with controlled pres-
sure. Five hundred cc. or more of citrated
whole blood is given routinely during the
operation. The operative approach to the
lung varies according to the preference of
the individual surgeon.[1 7 8 9 37,38 67,69 73] The
posterolateral incision is the most com-
monly used; the lateral incision or the
anterior incision is also used. Some oper-
ators resect a rib, others cut them pos-
teriorly or anteriorly and make the incision
in the interspace. We have tried several
ways and believe that a lateral incision
through the rib interspace with sharp divi-

sion of the costal cartilage anteriorly gives good exposure and less subsequent discomfort to the patient. If the ribs are cut

bronchi is less likely to result in bronchopleural fistula. Used properly the tourniquet will allow an adequate resection. The
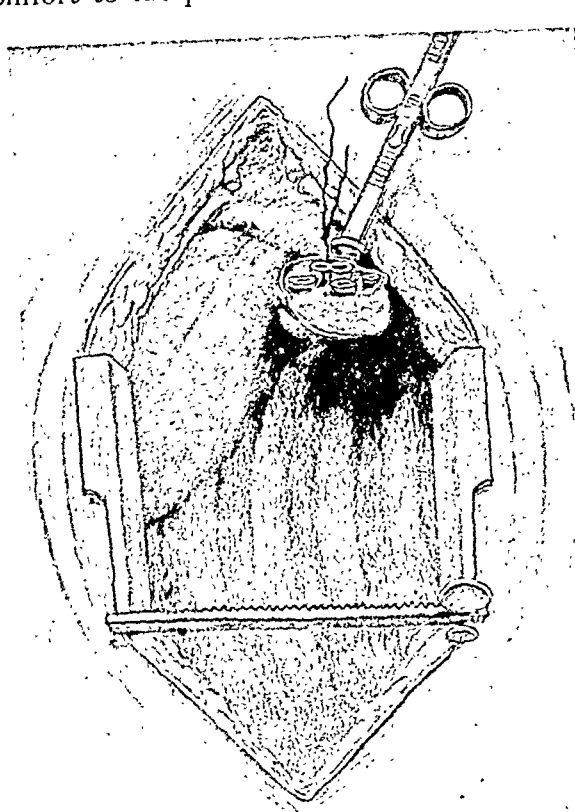
FIG. 4. Suture of lower lobe hilar structures.
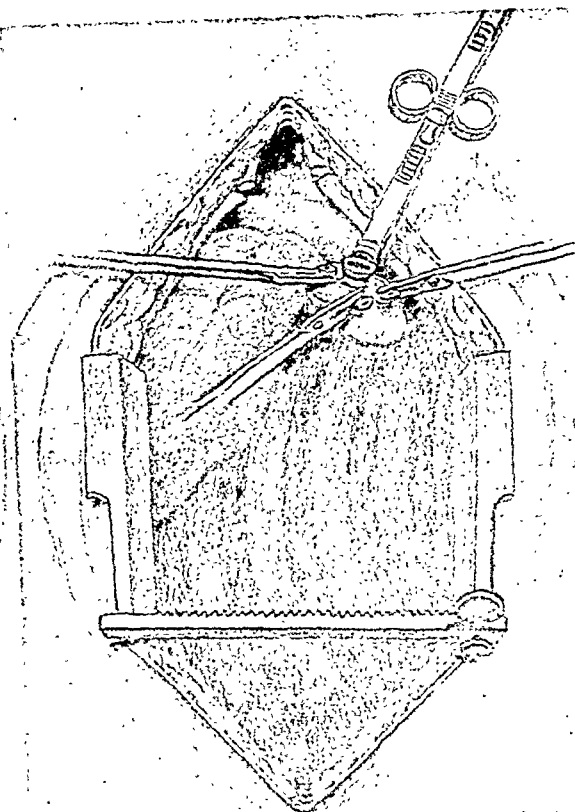
FIG. 5. Dissection and ligature of hilar vessels and suture of bronchus.

posteriorly, a small section should be removed to avoid postoperative overlapping, friction, and pain. Injection or crushing of the involved intercostal nerve from within the chest upon the completion-of operation may give a temporary interruption of the nerves, with relief of the pain. The drawings in Figures 1 to 4, although diagrammatic, indicate our operative method.

As shown in Figures 3 and 4, there are two main ways of treating the hilar structures, the use of a tourniquet or dissection of the hilar structures with individual clamping of the vessels. The latter method is probably more accurate, but there is one thing to be said for the tourniquet method; it is easy to use and the subsequent suturing and closure of the bronchi involve the secondary divisional bronchi. There has been the belief and some recent evidence tends to show that suture of the secondary

anatomical dissection of the hilar structures is the more accurate method, however, and with the present knowledge and methods of handling the bronchial stump is considered the best way to handle these structures.[1,15,18,58]

At the close of operation we always insert a catheter into the region of the removed lobe or lobes, place sulfonamide in the chest and gently re-expand the lung just before closure. The catheter is attached to constant Wangensteen suction as soon as the patient is returned to bed and left in place four to five days. We believe that the first twenty-four hours of suction on this tube is of the utmost importance in the postoperative care. This maintains or brings the remaining lung out to the chest wall in full expansion. After twenty-four hours the remaining lung probably becomes adherent to the parietal pleura and will not

become atelectatic. In addition the suction tends to stabilize the mediastinum in the normal position, prevents subcutaneous emphysema, and removes the irritative pleural fluid that results from the operative manipulation and exposure, or the presence of the sulfonamide.

CASE REPORTS

CASE I. W. S., a seaman, age fifty-one, had a bronchiectasis of the right lower lobe, cause undetermined. He was operated on December 7, 1942, and recovery was essentially uneventful. The patient had a good result and is working at the present time.

CASE II. D. J. G., in the Maritime Service, age twenty-two years, had a bronchiectasis of undetermined cause, of the left lower lobe. He was operated on March 29, 1943. Recovery was essentially uneventful and the patient is now working.

CASE III. D. G., a colored male, age forty-five years, a veteran of World War I, had an abscess of the right upper lobe which bronchograms revealed to be on the basis of a bronchiectasis of the right upper lobe bronchi. He was operated on June 17, 1943. This was a somewhat difficult case as the apex of the lung was plastered to the apical pleura by dense, fibrous adhesions, and considerable manipulation of the lung was required to develop the hilar area. The patient developed a severe left lower lobar pneumonia which did not respond to intensive medication including blood transfusions. He died July 13, 1943, with left lower lobar pneumonia.

CASE IV. M. W., age thirty-two years, a seaman, was transferred to our hospital for treatment of an abscess of the right lower lobe, which bronchograms revealed to be on the basis of bronchiectasis, and which was confirmed on pathological examination. A right lower lobectomy was done January 25, 1943 and recovery was uneventful. He was seen and examined nine months later and was working and in good condition. X-ray revealed some elevation of the diaphragm, but the chest was otherwise normal.

CASE V. W. R. E., in the Maritime Service, age thirty-six, entered the hospital with an abscess of the lower lobe of the left lung. Bronchograms revealed bronchiectasis of the lower left lobe. On June 6, 1943, a lobectomy of the left lower lobe was done. The patient's

recovery was uneventful. On October 3, 1943, the patient was working and had no complaints. On February 12, 1944, a letter from the patient stated that he had an abscess of the upper lobe of the left lung and that he had been discharged from the Maritime Service. The patient again wrote that the abscess had cleared up rapidly and that he was back at his old work.

CASE VI. J. C. B., was a Coast Guardsman, age twenty-four. Bronchograms revealed that the patient had a bronchiectasis of the left lower lobe due to unknown cause. He was operated on July 9, 1943, and left lower lobectomy was done. The patient made an uneventful recovery. Six months later the patient stated that his weight was back to normal and that he was back on duty.

CASE VII. W. E. P., a Coast Guardsman, age thirty-six, had a history of recurring bronchitis and sinus trouble. Bronchograms revealed a bronchiectasis of the right lower lobe due to infection. The man was operated on June 8, 1943, and made an uneventful recovery. In January, 1944, the patient was still in the Coast Guard and working. He had no complaints.

CASE VIII. F. E. A., a seaman, age twenty-one years, was examined and revealed a bronchiectasis of the right lower lobe. The patient was operated on June 6, 1943, and made an uneventful recovery. One year later the patient reported that he was working daily and his weight was back to normal with no complaints.

Eight cases of bronchiectasis are reported in which lobectomy was done. In this series there was one death. This patient had bronchiectasis of the right upper lobe and death was due to lobar pneumonia in the left lower lobe. The ages of these patients varied from twenty-one to fifty-one years. All were back at their usual work. One patient stated that he had been discharged from the Maritime Service because of a left upper lobe "abscess." He had been working since operation until this developed. He had had a left lower lobe lobectomy. Recently he reports that his left lung had cleared up and that he has returned to work. Several patients were in the Coast Guard at the time of operation and it is interesting to note that they

were afterward retained in the Coast Guard and at present are carrying out their usual duties. There were four right lower lobe lobectomies, three left lower lobe lobectomies, and one right upper lobe lobectomy. There were no empyemas, bronchopleural fistulas or other complications.

SUMMARY

1. A moderate review of the literature has been made and the importance of bronchographic diagnosis and surgical treatment has been emphasized.

2. The irreversible pathological changes that are a part of the picture of bronchiectasis are outlined, and the high incidence and types of complications are discussed.

3. The experience of various workers is discussed and figures cited relative to medical versus surgical management of the disease. These factors together with the present low fatality rate in the operative procedure appear to support our belief that lobectomy is the treatment of choice in bronchiectasis.

4. Eight cases of bronchiectasis in which lobectomy was done are reported and the technic which was used is outlined.

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EVALUATION OF THE TREATMENT·OF CANCER OF THE BREAST*

WITH A SUGGESTION FOR ITS MODIFICATION

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SO much has been written of cancer of the breast, that interest in the subject would cease to exist were it not for the fact that first, it represents 10 to 12 per cent of all cancers treated, and second, we are confronted with the statement that the medical profession has not increased its percentage of cures in the past twenty-five years, except through early diagnosis. Technically, the operation has shown only minor advances. It is a matter of common knowledge, common to the profession at least, that cancer in general, including the breast, is increasing and has not deviated from the original pattern in the main, although some refinements in the pathological diagnosis have been attained. The cancer of our grandmother is our cancer today. It is no cause for alarm or apprehension to note this increase in the frequency of malignancy.

Preventive medicine has eliminated so many diseases of childhood and adolescence that the average duration of life has been projected into the zones where malignant disease is the captain of the men of death, and takes its toll. As life is extended through prophylaxis and therapeutic discoveries, many diseases which are common now will cease to exist; and unless we discover the cause of cancer, or have means of eradicating it, the incidence of cancer will continue to spiral upward. This should not give us so much concern as the challenge that we have no better results in cancer of the breast today than we had three decades ago. It is difficult, maybe impossible, to refute such a state-

ment. I doubt very much if the radical mastectomy is done any better now than it was done by Halstead.

Probably the only notable advance in the treatment of cancer of the breast is early and positive diagnosis and by irradiation, either by x-ray, radium element or emanations. Outside of these measures, what advance has been made in the treatment? Scarcely any. And what has irradiation added? That is an involved question and the subject that deserves consideration not alone by the roentgenologist, but by the surgeon as well.

Warfare upon disease is in some respects like military warfare. It has been only too apparent that the various branches of our armed forces have met with their greatest successes by intelligent collaboration. If we can appropriate a lesson from that experience, it should be plain that all branches of our profession interested in the cure of cancer should unify their efforts in this direction and not be content to work alone in a restricted field. The surgeon, the roentgenologist, the pathologist and the internist should pool their knowledge and apply it to the problem.

The publicity given cancer has doubtless succeeded in driving into doctors' offices many cases of cancer early enough to be cured. It seems to be universally accepted that a radical excision of the breast for cancer before metastasis to the axilla or elsewhere, is followed by a five-year cure in 70 to 75 per cent of the cases. The profession seems more alert to the necessity of early treatment; the frozen section has

become almost routine in making possible a very early and accurate diagnosis, with its corresponding good prognosis.

I hope the day has long since passed when palpable axillary glands serve as a confirmatory diagnosis of carcinoma of the breast. It is almost safe to make the statement that when the original growth is fixed either to the muscle or skin, it has already metastasized, at least microscopically; no one can believe that carcinoma of the breast spreads by lymphatics alone, because it cannot explain early extension to the brain, lungs, or skeleton.

Many more cases of carcinoma are seen earlier than they were thirty years ago, and the number of patients rescued from a lingering illness has certainly increased; this can be credited to the better informed general practitioner and a public that is cancer conscious.

In those cases in which metastasis exists in the axillary glands or elsewhere at the time treatment is undertaken, the figures are reversed; we have 25 per cent cured and 75 per cent live less than five years, although many clinics present better figures, but for the country at large, the figures stand. It is evident that if we expect any satisfactory improvement in the present status of cures, we must be able to operate on more patients while the disease is confined to the breast or else find a means of overtaking metastatic invasion. This is the crux of the cure of cancer today, and it matters little if it can be done by surgery alone, irradiation alone or a combination of the two.

We should proceed to analyze the situation by breaking down the problem into its elementary factors: (1) The diagnosis of carcinoma of the breast must be by pathological examination only, for no series of cases with a clinical diagnosis only can be acceptable as a basis for comparative study. Even the punch biopsy is open to serious objections; any pathologist will verify the statement that only an exhaustive examination of sections will give a correct diagnosis in many breast tumors,

and a punch biopsy is of value only if malignant cells are seen. Therefore, reports of cures by irradiation or by surgery without pathological examination should be discounted. (2) Carcinoma of the breast with metastasis yields only 25 per cent five-year cures. Who is to say when metastasis is present? Is it the surgeon or the pathologist? Certainly it is not one who examines the patient prior to operation, when attempts to palpate glands in the axilla are usually futile. Deep metastatic extensions often cannot be palpated, and glands that are palpable in the axilla in a patient with carcinoma of the breast, are not necessarily malignant. Palpation will not differentiate the malignant and inflamed gland. The operating surgeon is better qualified, by mere proximity, to palpate glands, but here, too, the differentiation cannot be made by the fingers, although he can be reasonably certain of the diagnosis. Only the pathologist is qualified to pass judgment, and then only after a meticulous search through the axillary fat, backed up by an equally painstaking inspection of the slides. The percentage of error by microscopical diagnosis is small but not negligible. The borderline case, and certain types of mastitis, have been the source of error only too frequently; however, as long as the human element is involved, namely, the interpretation of a picture, errors will creep in. It is on the pathologist's statement that the prognosis is based. It may be modified by the grade of malignancy (Broder's classification) but in a large number of cases reported by many observers it can be stated as essentially true that only 25 per cent of cases with axillary metastasis remain alive after five years. This does not imply that 25 per cent are cured; if we took a ten-year period as a yard stick of cure, 5 per cent, possibly more, could be deducted from the 25 per cent as cured, omitting those who died of disease not associated with cancer of the breast. Twenty-five years ago, we were satisfied with a three-year cure; now we measure with a five-year period; is it fair

to ask what shall be the minimum period in 1965?

X-ray and radium were hailed as almost a panacea for cancer of the breast; for some years considerable faith was placed in this treatment. Outstanding roentgenologists apparently proved to the satisfaction of themselves and to some surgeons that there was a considerable extension of life after irradiation. This view has not been fully sustained by reports of Crile, Adair, the Mayo Clinic, and others. If longer life has been granted these individuals, it has been but an average of only a few months. It has not been shown that the age of the patient or the grade of carcinoma can be taken into consideration in the use of irradiation, from a prognostic standpoint. The type of carcinoma may offer a clue as to whether the extension of life will approach the five-year mark or the one-year mark, but these cases do not lend themselves to spectacular results with x-ray or radium. We talk glibly of irradiation sensitivity but this must not be confused with curability. The two may be related but are not synonymous.

It must be accepted at the present time that radical operation, plus irradiation, is all that we have to offer in cancer of the breast with metastasis, and be content with a mortality of 75 per cent in the next five years. The prognosis may be modified by the type and grade of tumor; from a recent report, age is not a factor, although it is contrary to my personal experience.

In the records of any surgeon, case after case can be found in which carcinoma of the breast with axillary metastasis was treated by a radical mastectomy followed by irradiation in a series of treatments, concentrating on the paths of extension. All goes well for two or three years, then swelling of the arm becomes annoying, a non-productive cough may be a persistent symptom, or vague pains in the back or pelvis send the patient to his doctor; the answer is only too evident—metastasis beyond the hope of cure by any known means.

We believe that irradiation does retard or partially arrest malignant growth, particularly those malignancies that are sensitive to the rays. The changes which occur in malignant tissue as the result of x-ray treatment bear this out. It would appear that malignant cells, less viable than normal cells, are destroyed or immobilized by irradiation, but some become activated after a long dormant period.

McCarthy and Leddy, of the Mayo Clinic, have recently reported some interesting observations on the roentgen treatment of inoperable carcinoma of the breast. It covers a series of ninety-eight patients between 1925 and 1940, in which the multiple converging beam technic was employed in a series of treatments lasting from a few months to four years.

To quote, "Those patients who received three or more courses of multiple converging beam therapy lived slightly more than a year and a half after treatment had been started. We believe that only the patients who were treated three times received adequate roentgen therapy."

Two patients each sixty-five years of age had lumps in their breasts, ulceration, fixation, and lymph nodes. Each received eight and nine courses of treatment for a period of four years.

"Re-examination at the clinic just prior to the cardiac exitus in each case failed to reveal any clinical evidence of a malignant process. We mention these two patients merely to illustrate what can be accomplished."

It appears to us that we have neglected a very valuable agent, or have failed to use it in an intelligent manner. Irradiation prior to operation has probably not been used to its best advantage. There is probably a field for this type of therapy and it should consist of concentrated radiation for two or three days followed by operation in four or five days. Inhibition of cell activity to a variable degree and period of time may be expected, but sclerosing changes develop in a slower fashion, consequently the fusing of soft tissues is not encountered in an early operation.

If it is possible to arrest malignancy for two years by irradiation, would it not seem most rational to repeat the treatment in two years, and again in two years, to attenuate and eventually destroy the malignant cell? So far as we know, no systematic plan has been followed to treat carcinoma of the breast by irradiation at stated periods after the original treatment. It is not believed, of course, that immunity to cancer can be established by any form of treatment. Fractional or periodic irradiation spaced two or three years apart may arrest or destroy feeble cancer cells which have become activated after a single series of treatments. Whether the death of the cancer cell is due to incarceration in a fibrous ring, or to direct action of the ray is immaterial; if they can be held in a state of inactivity in excess of the five years, we can probably increase the number of cures as well as the period in which the patient remains well.

I am convinced that periodic irradiations spaced two or three years apart has nothing to lose, but perhaps much to gain. I am instituting this type of treatment in patients who apparently are cured; at least they present no clinical evidence of recurrence. It will be difficult to get all patients to cooperate but this in itself will be no cause for regret, as the two groups, those who have periodic x-ray and those who do not; form a control group and a treated group, but it will take some years to arrive at any conclusion that will be acceptable. In five years there will be enough data to encourage further studies or to abandon the principle of surgery plus periodic irradiation.

SUMMARY

In the treatment of cancer of the breast, we have reached a place where the prospects of reducing the early mortality or extending the span of life seems to have reached an impasse, unless we can better apply the tools at our disposal.

Much has been accomplished by publicizing the prevalence and curability of cancer in its early stages, and while these efforts should be continued, no great impression will be made in the vital statistics by this alone.

No longer should carcinoma of the breast be so designated without miscroscopical examination of the tissue, and compilation of cases treated without such verification should not be given printer's space. The punch biopsy only in its positive reports of carcinoma is entitled to any consideration from a diagnostic standpoint, and it would be far better if the method were abandoned altogether. Brodus has definitely established the value of grading cancer, and every effort should be made to get in line with his observations.

We have two methods of attacking cancer of the breast, irradiation and surgery, and it is very questionable if we have exhausted the possibilities of the two, particularly as a dual method of attack. There has been too much half-hearted cooperation between the surgeon and roentgenologist. Irradiation alone has not lived up to the expectations; or possibly too much was anticipated, no doubt predicated upon a limited experience or a few outstanding cases. If the methods of treatment by irradiation now in vogue have failed materially to increase the number of cures or prolong life, possibly the utilization of this potent therapeutic measure can be better adapted and coordinated with surgery.

It is conceded that irradiation inhibits many malignant growths, and any treatment that can arrest the propagation of cancer cells has a place in the treatment of cancer. Combined with surgery, irradiation can play an important part in the treatment of cancer of the breast.

Preoperatively, a short period of intensive treatment by x-ray or radium, should be followed immediately by radical surgery. Irradiation alone, or delayed surgery after irradiation has not been justified by the end results. Postoperative irradiation has been rather "hit or miss" in its application, no effort apparently having been made to standardize the treatment in dos-

age, periodicity in relation to the operation or careful tabulation in regard to the extent, type or grade of cancer, except in few of the centers in which this problem is a matter of major importance. Unfortunately perhaps, most of the cases are not treated in the best organized clinics.

The postoperative treatment of cancer of the breast, we believe, needs coordinating. Irradiation should be carried out early in the convalescence of the patient and repeated at two-year intervals regardless of recurrence or in the absence of recurrence, over a period of four to six years, assuming the patient survives.

Notations as to the type and grade of cancer, metastasis, local recurrences are essential to supply data that can be applied to formulate future treatment of carcinoma of the breast.

Until we utilize irradiation in an intelligent manner in combination with surgery, we shall just muddle along in a therapeutic rut. It is incumbent upon us to apply, with a sense of responsibility, all those measures that we have in our hands and not casually wait for some genius to throw in our laps a specific "carcinomastat." This program will require years to consummate, but it will be worth the labor.

FROM pelvic organs, metastases are found in the iliac nodes first, next the inguinal nodes, then to the skin through the vasa lymphatica abdominis.

From "Metastases Medical and Surgical" by Malford W. Thewlis (Charlotte Medical Press).

BENIGN TUMORS OF THE VULVA

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BENIGN tumors of the vulva are rather uncommon. Their appearance should be recognized early if we are to practice preventive gynecology and thus control vulvar cancer. Less than 200 cases have been reported in the literature which contains many excellent reviews and treatises on experiences with vulvar tumors. In this paper we are concerned with benign tumors of the vulva accompanied by a classical case.

ANATOMY

The vulva includes the labia majora, labia minora, mons pubis, clitoris, and those structures contained in the labia, including the glands of Bartholin. The meatus urinarius and hymen, although not entirely vulvar in origin, are often considered as a part of the vulva because of their close relation to other vulvar structures. The skin and accessory cutaneous structures of the vulva occupy an important relationship to the vulval integument of the human female. The generally benign character of simple tumors developing in these structures has created little respect for their occasional malignant propensities. Benign tumors of the vulva are an interesting group, because of the above variety of tissues in this area of the human body.

GENERAL CONSIDERATIONS

Incidence. Fibromas and fibromyomas arising from the external genitalia in women are comparatively rare. The exact incidence is unknown. Burr, in 1905, at the University of Michigan Hospital, did not find a single case of vulvar fibroma in 5,000 cases tabulated on the gynecologic service. Leonard, in 1917, at the gynecological clinic of Johns Hopkins Hospital found only six fibromas of the vulva among the 23,000 patients admitted to the hospital. In 1929, Brady stated that less than 175 fibromas of the vulva have been reported in all medical literature. A further search through the literature has not revealed many more case reports on the subject, but many authors have placed greater emphasis on vulvar tumors with special reference to both their benign and malignant characteristics. Undoubtedly many more cases of benign tumors of the vulva have been seen, recognized and treated. Fibromas of the vulva are of sufficiently rare occurrence to make the report of a case worth while.

Heredity. At present there is no accurate information concerning the relationship of fibromas of the vulva to heredity.

Age. Vulvar fibroma rarely manifests itself in infancy or adolescence. Cases on record demonstrate the initiation of symptoms at the age of sixteen (youngest) and sixty-nine (oldest), although the majority in a series of thirty-four cases were of childbearing age, ten were more than fifty years of age. Aichel, in 1912, reported a case of a fibrous tumor appearing at the vulva of an infant. The vascular changes accompanying menstruation and pregnancy are shared by these tumors. This is clearly demonstrated by the swelling and sensitiveness experienced by patients during those periods. Herein lies the explanation of the theory that, generally, vulvar fibromas occur in the childbearing period.

PATHOLOGY

The majority of benign neoplasms of the vulva are of connective tissue origin: fibromas, leiomyofibromas, lipomas, hemangiomas, neuromas, leiomyomas, ganglioneuromas, lymphangiomas and enchondromas. Of this group, fibroid tumors

are by far the most frequent of the benign solid neoplasms found in this region.

Benign tumors of the vulva of epithelial origin include true papillomas, condylomas, endometriosis, accessory breast tissue, epidermoid cysts, hidradenomas or sweat gland adenomas of the vulva and moles.

A large group of the vulvar neoplasms of connective tissue origin originate in the extraperitoneal portion of the round ligament. Commencing on either side at the lateral angle of the uterus, this ligament is directed forward, upward and lateralward over the external iliac vessels. It then passes through the abdominal inguinal ring and along the inguinal canal to the labium majus, in which it becomes lost. According to Leonard, as many as 33 per cent of these tumors arise in this manner.

Nearly all fibromas show degenerative changes if allowed to develop for too long a time. Neoplastic fibroid tumors of the vulva are more prone to degenerative processes than similar tumors in any other part of the body. Due to the fact that these tumors are subjected to marked variations in their blood supply during menstruation and pregnancy, which causes rapid growth, and by growing rapidly the majority soon become pedunculated, they develop ideal mechanical conditions for degenerative processes. Lovelady in discussing the pathology of sixteen fibromas, found that the majority were made up of fairly adult fibroblasts, which formed spindle cells, and varied in diameter from 6 mm. to 8 mm. Mitotic figures were not demonstrated. Myxomatous degeneration was a common finding. Although several of the fibromas were cellular none were considered sarcomatous. Hellman in a series of sixty-four cases found malignant changes in fourteen cases or 22 per cent. Leonard showed that nearly one-fifth of these tumors (nineteen of 103 cases) became sarcomatous. Folsome at the University of Michigan Hospital found sarcomatous changes in one of nine cases, an incidence of 11 per cent. Other pathological changes which have been described in the literature relative to degener-

ative processes in benign vulvar tumors are edema, lymphangiectasis, hyaline and cystic degeneration, calcification, ulceration, infection and gangrene.

CLINICAL MANIFESTATIONS AND COURSE

The lack of clinical symptoms in cases of benign tumors of the vulva is an outstanding feature. The tumor when first seen usually appears as a small, firm, smooth, painless round or oval nodule immediately under the skin of the labia majora. The tumor may be discovered by the surgeon during a routine pelvic examination but usually it is the tumor's rapid growth which brings the patient to him for consultation.

The tumor usually becomes pedunculated and with continued growth produces symptoms due chiefly to the weight and location of the mass. Actual interference with locomotion or mild urethral irritation, if the tumor mass involves or pulls the urethra, may be the first inconvenience experienced by the patient. Likewise the weight may cause mechanical difficulties by interfering with the urinary sphincter mechanism causing frequency or urinary incontinence. Occasionally, pain with ulceration of the epithelium over the neoplasm causes the patient marked mental distress concerning the possibility of malignant change in the tumor. Large tumors may prevent coitus or become an obstacle at labor.

These tumors when first seen have in most cases, a definite well marked pedicle, which hanging between the thighs bears a remarkable resemblance to a male scrotum thus presenting a clinical entity and illustration, which cannot be forgotten easily. The tumor is generally covered with hair. The skin is thick and reveals numerous wrinkles and shallow folds, especially between menstrual periods. The literature comments frequently on the remarkable resemblance of some of these tumors to the scrotum and in one case, a diagnosis of hermaphroditism was made, the firm, rounded elastic tumor being mistaken for

a testicle. The skin is freely movable over the tumor, and its surface is generally quite unbroken, although there may be several small areas of epidermis presenting a glistening appearance which is usually due to friction.

On palpation, the tumors seem to consist of rather firm, smooth or slightly lobulated tissue of the same consistency as fibromas elsewhere in the body. Moderate pressure does not produce pain. One or more pulsating vessels may be felt in the pedicle. If the circulation becomes impaired the tumors may become semifluctuant or edematous. Sometimes by pulling the tumor thereby making tension on the pedicle, a tough fibrous cord may be made out transversing the pedicle and entering the inguinal canal, indicating that the tumor is of connective tissue origin and arises from the round ligaments.

These tumors vary greatly in size, some of them remaining as small non-symptomatic nodules while others grow to enormous size, thus interfering with locomotion, childbirth, intercourse, and are equally disturbing from a psychological standpoint. Buckner, in 1851, reported a very large growth, said to have weighed 121.5 kg. (268 pounds) which arose in the subperitoneal connective tissue and appeared at the vulva.

DIAGNOSIS

The diagnosis of fibromas of the vulva is in most cases relatively easy when based on a detailed medical history and a complete physical examination. Biopsies from various portions of the tumor are necessary to rule out malignant changes and confirm the diagnosis.

DIFFERENTIAL CHANGES

The differential diagnosis of benign vulvar tumors can be based on either their connective or epithelial tissue origin. If they arise from connective tissue, they are either fibromas, leiomyofibromas, leiomyomas or lipomas. In rarer instances they may be hemangiomas, lymphangiomas, neuromas or enchondromas. Those arising from epithelial origin may be papillomas, condylomas, hidradenomas or sweat gland adenoma of the vulva, supernumerary vulvar breast tissue, endometriosis, or cystic tumors of the vulva.

The clinical and pathological descriptions of the above mentioned disease entities are well covered in the literature and in textbooks of surgery, pathology and diagnosis. No attempt will be made here to go into any great detail in giving the clinical differentiation of the above benign vulvar tumors. Some illustrative cases have been selected from the literature, however, to emphasize the importance of making an accurate differential diagnosis.

Occasionally benign fibromas of the vulva are confused with lipomas. Vulvar lipomas are prone to become pedunculated because of their location and the tissues to which they are attached being stretched out to form a broad thin base. Lipomas usually grow very slowly, and, as they are quite painless very seldom cause inconvenience. It is for this reason that not a large number of these cases have been brought to the attention of gynecologists. Kelly, in 1893, pointed out that lipomas of the vulva, in turn, were likely to simulate inguinal hernia. In such cases further differentiation must be made because tumors originating in the extraperitoneal portion of the round ligament can be mistaken for a hernia.

Endometriomas of the labia majora, as reported by Jeffcoate in 1937, have also been found in close connection with the round ligament. Henry reported a case of an endometrial growth on the right labium majus, which he believed was due to transplantation of endometrial cells into the tissues of the labium majus as a result of injuries during childbirth or their lymphatic or venous dissemination, more probably to the latter.

Several investigators have reported accessory breast tissue in the vulva, and Folsome, in 1929, removed a small endometrioma from the mons pubis of a young

woman. Adenomyomas should not be confused with lipomas. Adenomyomas cause severe pain each time menstruation occurs because of swelling and hemorrhage in an adenomyoma at the menstrual periods.

Sometimes the gross and microscopic study of a tumor justify a diagnosis of fibroma of the vulva, because of the preponderance of fibrous tissue; but if there is also an abundance of inflammatory cells and granulomatous tissue, lymphopathis venereum or a syphilitic infection must be considered. A definite choice between these two diagnoses, however, is impossible, as the history and laboratory could support either thesis. In such cases the passage of time and further observation are indispensable.

Cystic tumors of the vulva have been reported by Brady who described a fibroma of the vulva which contained an epithelial inclusion cyst, a tube lined with several layers of squamous cell epithelium and Schauffer and Lunsford described a lymphatic cyst. Elephantiasis of the vulva, sweat gland tumors or hidradenoma and retention cysts of Bartholin's gland and sebaceous cysts have also been reported.

TREATMENT

The treatment is surgical excision. The specimen or tissue removed should always be examined by a competent pathologist. The surgical technic is very simple, and entails usually an elliptical incision about the base of the pedicle, ligation of vessels, and closure of the wound with or without drainage.

CASE REPORT

The case I wish to report is of interest because of the relatively rare occurrence of fibroma of the vulva and because early recognition and treatment of vulvar lesions and tumors will lower the incidence of sarcoma of the vulva.

The patient, a colored obese female, aged twenty-six, was admitted to the Station Hospital, March 27, 1943. She was married

and had one child. The family history was unimportant. Personal history revealed that the patient married at the age of fourteen, and
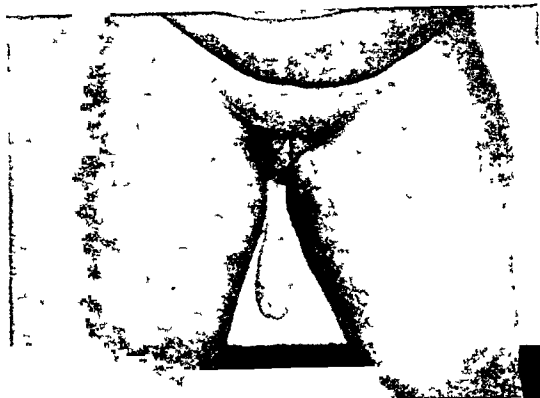
FIG. 1. Photograph taken March 29, 1943, showing the position of the benign fibroma when the patient stands in an upright position. It dangles freely between the thighs, and in this position interferes with locomotion and coitus. Note the striking resemblance to a male scrotum.

delivered a normal, viable male child, one year later. She divorced her husband when she was eighteen and remarried at the age of twenty-five. Menstruation began at the age of thirteen and continued normally. She had had no further pregnancies or abortions, but had been treated for the past nine years for leucorrhea. Other than the local trouble the past history was non-contributory and of no consequence.

About five years before admission the patient noticed a very small firm, itching nodule just to the left of the vaginal orifice. It was not sensitive, and at its onset it looked like a "mole." For the past four years it grew very slowly but quite steadily. During the one and one-half years before admission the tumor rapidly increased in size.

For the past two years, during the menstrual periods, the tumor had usually become swollen and slightly sensitive. At the end of four or five days the swelling and sensitiveness would subside, only to recur with each menstrual cycle. The only discomfort was caused by its size and weight, and its interference with coitus and locomotion. She learned to accommodate herself to the presence of the vulvar tumor by strapping it to her abdomen.

On several occasions the apex of the tumor became quite painful and ulcerated, the last episode occuring six months before admission. She saw four colored physicians over a period

of five years, all of whom recommended surgery, but the patient refused such treatment.

Examination (Figs. 1 and 2) revealed a

were no ulcerated areas. The pedicle and mass were not covered with hair, and the apex of the tumor (Fig. 3) had a scarred, indurated, gran-

FIG. 2. Showing the attachment of the tumor to the left labium majus.

FIG. 3. The apex of the tumor has a scarred indurated, granular appearance, with central infolding and dimpling.

pedunculated tumor covered with thick elastic wrinkled skin hanging from the left labium
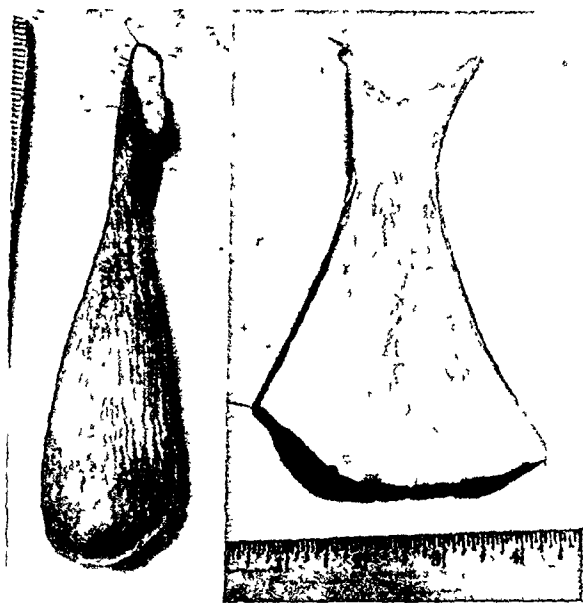
FIG. 4.   FIG. 5.

FIG. 4. The tumor following surgical excision. It consists of a polypoid mass about 6 cm. in diameter with a pedicle 1.5 cm. in diameter. It is covered with hairless, wrinkled, pigmented epithelium.

FIG. 5. The tumor split open. It is composed of fibroblasts having spindle-shaped nuclei. They are supported by a very abundant mass of collagen. The tumor is not very cellular. There is considerable interstitial edema. There is no evidence of malignancy.

majus. In appearance the resemblance of the tumor to a male scrotum was striking. There

ular central infolding and dimpling appearance. From the base of the pedicle the tumor measured 15 cm. The pedicle was 1.5 cm. in diameter and the tumor mass 6 cm. in its greatest diameter. There was no impulse over the left femoral or the left inguinal rings. The vaginal examination revealed a large fibrotic uterus, freely movable and non-tender. Due to the patient's weight (215 pounds) the adnexal regions were difficult to palpate, and the examination of the tubes and ovaries was not especially satisfactory. It was believed, however, that there was no adnexal disease. The fibroma, because of its location and attachment to the left labium majus, apparently had originated from the terminal fibers of the round ligament.

On March 29, 1943, under local infiltration anesthesia with 1 per cent novocaine, an elliptical incision was made around its base and the tumor removed. (Fig. 4.) A few small bleeding points were ligated with No. 000 plain catgut. The subcutaneous tissues were approximated with three No. 000 plain catgut simple interrupted sutures. The edges of the incision were approximated with a continuous No. 1 black silk mattress suture, restoring the left labium majus to its normal size and shape. No drains were used due to the absence of infection or degeneration. The convalescence was uneventful and healing per primum followed.

The patient was discharged as cured April 4, 1943. She was seen again on April 15, 1944.

There was no evidence of recurrence of the tumor mass, and the patient was asymptomatic and in excellent health.

Pathologically the specimen (Figs. 4 and 5) consisted of a polypoid mass about 6 cm. in diameter with a pedicle 1½ cm. in diameter. It was covered with wrinkled, pigmented epithelium and was composed of edematous fibrous tissue.

Microscopically, the tumor was composed of fibroblasts having spindle-shaped nuclei. They were supported by a very abundant mass of collagen. The tumor was not very cellular. There was considerable interstitial edema. There was no evidence of malignancy and we consider the tumor to be a true fibroma.

SUMMARY

The varied manifestations of benign vulvar tumors are reviewed to re-acquaint physicians with the disease, since less than 200 cases have been reported in the literature. A classical case is presented in detail, clinically and pictorially.

Sarcoma of the vulva may be prevented if benign vulvar simple lesions and tumors are recognized and treated early.

If this treatise serves its purpose, there should be more correct diagnoses, and fewer benign lesions allowed to proceed to a stage of malignant degeneration.

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TREATMENT OF COMPRESSION FRACTURE OF THE SPINE*

WITH A REPORT OF 160 CASES AT FORDHAM HOSPITAL

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THIS paper is not intended to be a detailed article covering the entire field of compression or crush fracture of the spine, as contributions to the literature on this subject have been extensive, many of them excellent. Although some of the suggested treatments have differed in detail, the general plan is the same. This article is rather a sequel to a report of forty-nine cases of this nature which I had encountered at Fordham Hospital from 1916 to 1929.[1] With fractures in general on the increase, the occurrence of compression fractures is of course more frequent. We had from 1916 to 1943 inclusive, a total of 339 cases of spinal fracture. A complete study of these cases may be of some value now with the emphasis in the literature and in the military hospitals on every type of severe injury.

Frequency of Occurrence. Table 1 shows the spread of these cases through the years from 1916 to 1943. The total is 339 of which 160 (or 47.3 per cent) were compression fracture, clearly indicative of the frequency of this type of fracture.

Types. Two types of fracture of the spine are most frequently encountered: (1) *Compression fracture* of the body of the vertebrae, sometimes called crush fracture, 47.3 per cent in the series here reported. The vertebrae of the dorsolumbar junction, i.e., lower two dorsal and upper two lumbar are the ones most frequently involved. Table III gives the exact location according to the x-ray findings; (2) *fracture dislocation*, besides the fracture of the body, the upper adjacent vertebral body is

dislocated, usually anteriorly, sometimes laterally.

Pathology of Compression Fractures. In general the ends of the vertebrae are forced together, thus causing crushing or compression of the vertebrae. We have three degrees of compression fractures: (1) Mild compression: Slight wedge-shaped deformity, little or no apparent damage of

TABLE I
NUMBER OF CASES ADMITTED

Year	Total No.	No. of Compression Fractures	Year	Total No.	No. of Compression Fractures
1916	4	2	1930	18	5
1917	9	4	1931	15	7
1918	1	1	1932	16	9
1919	4	3	1933	10	4
1920	4	2	1934	12	6
1921	5	4	1935	24	12
1922	11	5	1936	26	11
1923	7	1	1937	17	9
1924	7	2	1938	27	12
1925	9	5	1939	21	10
1926	14	4	1940	17	11
1927	19	8	1941	15	11
1928	6	4	1942	10	2
1929	8	4	1943	3	2
Total.	108	49	Total.	339	160

Percentage of compression fracture to the total number is 47.3%.

articular end plates of the centrum, little or no change in the width of the intervertebral space. (2) *Severe compression:* Marked wedged-shaped deformity, fragmentation of articular end plates, and extensive disorganization of the intervertebral disc showing narrowing or obliteration of the intervertebral space.

(3) Central compression: No wedge-shaped deformity. Instead the central portion of the articular surface of the body collapses while the peripheral elements remain relatively intact thus imparting a crater shape or concavity to the compressed portion. Extensive disruption of the intervertebral disc is present, shown by the loss of the intervertebral space.

TABLE II
SEX

	Total No.	Compression Fracture	Percentage
Men	160	116	72
Women	173	44	27

Pathology of Fracture Dislocation. If some portion of the vertebral arch is also involved, a dislocation occurs and the upper adjacent vertebra is dislocated anteriorly or laterally.

TABLE III
REGIONS INVOLVED ACCORDING TO X-RAY FINDINGS

			Per Cent
1. Cervical	1– 4	12	7 5
	4– 7	26	16 2
2. Dorsal	1–10	12	7 5
	10–12	26	16 2
3. Lumbar		84	52

Note: For double cases, counted in the region before

Two bodies
Cervical and dorsal — 3
Dorsal and lumbar — 3
Lumbar — 18
Three bodies
Dorsal — 2
Lumbar — 3

Pathology of Intervertebral Disc. In spinal injuries the amount of damage to the intervertebral discs varies considerably. In the cases of severe compression the disc is disorganized and nuclear material forces its way through rents in the annulus fibers, the fracture lines in the articular end plates of the body and into the spaces of the spongiosa. The nucleus pulposus may be ruptured into the spinal canal.

Occupations. While the patients have been tabulated according to occupations (Table IV), one cannot draw any definite

conclusion from these cases as to which occupations are more prone to produce accidents. First, this report includes cases occurring the years of prosperity, the years of depression, and the years of defense

TABLE IV
OCCUPATIONS

Laborer	27
Unskilled laborer	12
Driver	8
Student	12
Baker	2
Painter	8
Housework	22
Clerk	7
Salesman	3
Professional	4
Iron work and construction	3
Telephone repairman	1
Bricklayer	4
Steam fitter	5
Carpenter	1
Fireman	2
Letter carrier	1
Auto mechanic	1
Manufacturer	1
Elevator man	1
Dress maker and milliner	2
Weaver	1
Waitress	1
No occupation	18
Undetermined	13
Total	160

work, the trend of occupations changing constantly. Secondly, Fordham Hospital is not situated in a location where heavy industries, as steel making or mining, are carried on. The hospital is situated in the northern part of the Bronx, mostly a residential section. However, it covers an area of dense automobile traffic, hence many automobile accident cases are brought into the hospital. The occupation listed, therefore, may have very little to do with the injury.

Etiology—Direct and Indirect. A direct cause is any injury causing forcible hyperflexion of the spine or jacknifing of the spine, e.g., fall from a height, a blow from a heavy object falling on the shoulders, an automobile accident or a diving accident. Indirect causes may be a sudden uncoordinated demand on the muscles of the back as in a sudden turn of the trunk or by a misstep; violent contractures of

the extensor muscles of the back have led to fractures of the fourth and fifth lumbar vertebrae. (This was a frequent occurrence when metrazol was administered in dementia praecox.)

TABLE V
CAUSE

Direct injury (including falls)....... 130
Indirect injury (including jumping). 17
Diving........................... 8
Unknown....................... 9

Table v gives the etiology of the fracture in its subdivisions. While we attempt to ascertain the history as to just how the injury was incurred, the information is not always reliable. Since so many are due to falls from windows or to automobile accidents, it is difficult to get a definite history as to whether the cause was direct or indirect.

Symptoms and Signs. Surprising as it may seem, some cases are not recognized because the patient is able to walk after the accident. Such patients are x-rayed a few days or weeks afterward mainly because they still complain of backache. The diagnosis of fracture of the spine is only then established.

The symptoms are: (1) shock in varying degrees; (2) pain in the involved portion of the spine and also referred to the chest or abdomen; (3) limitation of motion in all directions. (In sprains it is only in certain directions.) The limitation of motion is due to spasm. (4) Local tenderness of the spinous processes, better elicited by lateral pressure applied to the spinous processes; (5) abdominal distention, frequently follows compression fracture. It may be due to paralysis ileus. There may be marked abdominal rigidity closely simulating intra-abdominal injuries. (6) Bladder retention for a few days; (7) deformity—an angulation kyphosis is usually present at the level of the lesion (due to projection of the spinous process). In early cases, the kyphosis may be lacking. (8) Involvement of the cord: In a considerable number of cases, especially in fracture dislocation, the cord may be

involved, giving partial or complete paralysis with loss of functions of the bladder and rectum. (Table vi.) (9) Later symp-

TABLE VI
SYMPTOMS IN RELATION TO PARALYSIS

	No.	Per Cent
With paralysis..................	40	−25
Without paralysis...............	120	−75

toms—Kümmels disease or post-traumatic kyphosis. In some cases, after a period of improvement, the patient develops pain and weakness of the spine. These are believed to be due to a rarefying osteitis.

Diagnosis. This should be made on the history of the injury, symptoms and x-ray findings. But if the x-ray is negative, another x-ray should be taken in ten days. Some cases are mild and may be missed. X-rays should include dorsal, lumbar and lumbosacral regions.

X-rays in Injuries of the Spine. The x-ray, of course, is the most important item both for diagnosis and for progress. The x-ray must be taken in the anteroposterior and lateral views. The latter is the more important one. Some suggest also an oblique view. The x-ray should be taken immediately, as soon as the patient reaches the hospital, before he is removed from the stretcher or blanket and without changing his position.

Prognosis. The prognosis depends upon the amount of injury to the spinal cord. If the cord is not involved and proper treatments are instituted early, the prognosis is good, though it may take one or two years. Occupations requiring a considerable amount of muscular stress or strain may be resumed only after careful consideration of all possibilities; some occupations naturally may never be resumed. Due to frequent medicolegal entanglements, the symptoms are usually exaggerated.

Death in fractures of the cervical region is due to shock and pressure upon the

medulla; in the upper dorsal to hypostatic pneumonias; in the lower dorsal and lumbar, to cystitis, pyelitis and exhaustion.

TREATMENT

There are various procedures. The one here reported is used by me at Fordham and Bronx Hospitals and also in my private practice. The results compare favorably with those obtained by other methods.

First Aid and Transportation. So many books have recently been written on transportation, and the cautions to be observed are described at such length, that it is unnecessary to discuss the problem here. It is mentioned only to emphasize the point that the damage of the cord is often caused by improper transportation and not by the trauma.

The rule to follow is, that if a fracture of the spine is suspected, the patient is rolled over on his face and abdomen into a blanket. When lifted, the back sags downward and thus removes pressure from the spinal cord. The arms are placed at the side and the head is turned to one side.

When the neck is broken, he is carried on a rigid board (four feet long and twelve inches wide) with the arms resting at the side and face upward. In the hospital the shock is treated first.

Direct Treatment of Cases without Paralysis. The patient is at once put on a Bradford hyperextended frame. The hyperextension is gradually increased daily with the turnbuckle.

Stookey and others suggest that the patient be put on an air or sponge mattress. However, I do not recommend such a mattress since I believe that on it the patient is disturbed too much when given a bedpan.

Many patients complain of abdominal distention from the very beginning. The distention and the discomfort are increased when the patient is placed on the hyperextended frame. Therefore, many surgeons hesitate to put on a plaster cast

at once, but wait until the distention disappears; this takes a few days. The distention is usually due to paralysis ileus.

The patient remains on the frame for ten to fourteen days, until the abdomen is relaxed and the bladder and rectal functions are restored. Cornwell claims that if economic conditions permit, the patient should be kept on the frame for five to six weeks.

A plaster cast is then applied, using the Davis or Jones method or any device by which the patient can be held in hyperextension (best on the face) while the plaster is being applied.* The plaster cast extends from the suprasternal notch to just below the anterior superior iliac spines.

The cast is worn for eight weeks and then a brace, either of the Taylor or the Knight type with crutches under the arms, is put on. The patient gets physiotherapy while he wears the brace. The brace is left on till complete union occurs; this may take from eight to ten months. The intervertebral discs which are naturally disorganized by the trauma undergo replacement by fibrosis and become narrower even in the corrected cases. The general opinion of most surgeons is against such operations as spine fusion to hasten ankylosis.

Treatment of Fracture Dislocation of the Dorsal and Lumbar Spine Accompanying Compression Fracture. Placing the patient on the Bradford frame with traction and then hyperextension often reduces the dislocation. Subsequently it is treated by the same method as a compression fracture. (Table VII.)

Treatment of Compression Fracture with Cord Involvement (Paralysis). Contrary

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* In Davis' method the patient's head is on a low level and the legs and feet are elevated. I use this in fractures of the lumbar region. In Jones' method, the pelvis with the legs rest on a low table, while the head and upper part of the spine are raised on a higher table. I follow this method in fractures of the upper and mid-dorsal. In both methods the patient is on the face suspended between two tables and the plaster jacket applied.

to the previous general opinions that laminectomy is indicated in these cases, most surgeons, and the neurological surgeons are here included, believe that there is nothing to be gained by immediate operation. In cases of a complete transverse lesion of the cord, operative interference can do no good. In cases of incomplete lesion in which there are indications for operation, it is more beneficial to wait two to three weeks. Later, nerve operations are indicated in cases of progressive symptoms and in which adhesions are present. All patients with injury to the cauda equina should be operated upon, since the nerves of cauda equina are capable of regeneration.

TABLE VII

METHODS OF TREATMENT

1. Bradford frame alone......................	23
2. Bradford frame and cast...................	39
3. Thomas collar and plaster.................	5
Brace following cast or collar...............	18
4. Plaster jacket alone......................	33
5. No treatment given except general care........	18
6. Left or died before treatments were given.......	12
7. Other treatment: traction, collar or brace alone..	11
8. Bone graft operation......................	2
9. Laminectomy.............................	11

After 1918 every patient was placed on a Bradford frame. All these treatments are understood to include the frame. Most of the patients, on whom laminectomy was performed, came in the early years of these statistics. At that time, spine surgery was less highly developed than now.

Davis, in "Orthopedic Subjects,"[2] gives a careful discussion of the value of laminectomy in cases of partial or complete involvement of the spinal cord. "In cases in which complete paralysis is present, laminectomy is almost completely futile." He believes that "in affecting decompression, hyperextension, probably is as efficient as, if not more than laminectomy."*

Hopeless Paralysis from Fracture Dislocation. If after the first few days it is found that no recovery is taking place, and the patient shows signs of total paralysis at a definite level, and if there is

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* Davis, in the book mentioned, gives an excellent résumé of the treatments. It was intended for army surgeons and it can be read with a great deal of profit by other surgeons.

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incontinence of urine and feces, the principal problem is that of nursing care. It has been found that in order to prevent development of bedsores anterior and posterior shells should be made. These should be carefully molded to impress the soft parts and should avoid the bony prominences. Such shells should extend from the knees to the shoulder and suitable apertures should be made anteriorly and posteriorly. The shells should be strapped together with trunk straps and the whole ensemble should be mounted on a Bradford frame. The patient should be turned over two or three times a day, one shell being removed at a time in order to allow proper care of the skin. If the patient lives through the urinary complication, he may eventually be able to navigate with crutches or may spend the rest of his life in a wheel chair.

TABLE VIII

RESULTS ON LEAVING THE HOSPITAL

	No.	Percentage
1. Left before treatments were given..	12	7.5
2. Died before treatments were given..	10	6.3
3. Improved or cured................	111	69.4
4. Not improved—transferred to Psychop...................	3	1.9
5. Died from general causes..........	7	4.3
6. Died after operation..............	9	5.6
7. Died from cystitis................	5	3.1
8. Unknown.......................	3	1.9

Treatment of Urinary Complications. Where there is retention, the urological surgeon should be consulted to decide the method of drainage, whether by suprapubic cystostomy or by allowing the bladder to become distended and thus produce an automatic bladder.

Table VIII gives my results obtained in this series of cases. The large number of fatalities after laminectomy is due to the fact that many patients in the earlier years of this group were subjected to this operation whereas later the neurologists and neurological surgeons would have

hesitated to recommend such radical treatment or would have treated them conservatively.

Up to 1929 we operated upon nine patients with fatality in seven. From 1929 till 1943 only two laminectomies were performed and even those patients died.

CONCLUSIONS

1. Every case of injury to the spine should be examined with extreme care to rule out fracture.

2. Immediate rest should be instituted until the examination is completed.

3. Radiographs should be taken in three views: anteroposterior, lateral and oblique.

4. If the roentgenogram is negative but the symptoms point to a fracture, another roentgenogram should be made in a few days as it may show the lesion.

5. Diagnosis rests on history, localized pain and stiffness of the spine.

6. Prognosis depends on the amount of injury to the spinal cord. If the cord is not involved and proper treatments are instituted early, the prognosis is good.

7. Fractures of the laminae, transverse and spinous processes, articular processes, the ribs, the bones of the extremities especially the os calcis, are frequently present, and these complicate the prognosis and influence the treatment.

8. Treatment consists of rest on a Bradford frame in a hyperextended position, then a plaster jacket or two plaster shells, and finally a spinal brace.

9. The conservative treatment is attended by excellent results. Good function may sometimes occur after four to six months of protection by recumbency and plaster jacket, though full recovery may not be obtained for one to two years. An occupation, however, requiring a great deal of stress and strain may sometimes not be resumed.

10. Early operation is indicated when the x-ray shows dislocated bone pressing upon the spinal canal.

11. A patient with fresh fractures should rarely be subjected to operative interference. In cases of a complete transverse lesion of the cord, operative interference can do no good. In cases of incomplete lesion in which there are indications for operation, it is more beneficial to wait two to three weeks. Later nerve operations are indicated in cases of progressive symptoms and when adhesions are present.

12. All patients having injury to the cauda equina should be operated upon, since the nerves of the cauda equina are capable of regeneration.

13. In late cases in which pain still exists, nature has not ankylosed the injured region of the spine and if patient wants to return to strenuous back-bending labor, ankylosing operations should be considered. Time is likely to be saved thereby and the patient permitted to labor without apprehension. The experience of the compensation companies however, is that these cases are worse off after the operation than before. Evidently the legal element is a factor.

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MARCH (FATIGUE) FRACTURES OF THE LONG BONES OF THE LOWER EXTREMITY AND PELVIS*

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MARCH fractures or "fatigue" fractures of the long bones of the lower extremity and pelvis are frequently overlooked. It is chiefly an occupational disease of military life, associated with intense military training. The incidence is low. In a nine-month period from September 1, 1943, to May 30, 1944, 10,953 orthopedic cases were seen at an Army Station Hospital. Of this number twelve march fractures of the long bones and pelvis were encountered.

The bones involved, in order of their frequency, were the tibia in six cases, the pelvis in three cases, the femur in two cases (one involving the lower one-third and one involving the neck), and the fibula in one case.

ETIOLOGY

All fractures of the march type are characterized by solution of continuity without obvious, single violence. The onset is insidious, and a long period of time elapses before the patient presents himself for treatment. The inexperienced medical officer frequently attributes the soldier's complaint to muscle strain, myositis, tenosynovitis or bursitis.

This condition has been described under various names: Pseudofracture, such as the case described by Weaver and Francisco who maintained that the condition was "a manifestation of non-suppurative osteomyelitis," insufficiency fracture, "umbauzone," wear-and-tear fracture, exhaustion fracture (Henschell), insidious or overload fracture, callous tumor, etc. George Brandt, of Mainz, wrote about a "creeping fracture," which described

one of the characteristics of this type of fracture but did not give any clue to its etiology.

Branch suggests that the fracture in the tibia is due to the upward swing of the leg and the resultant backward stress on the supporting leg during rigid marching. In the fibula he believes the fracture to be due to repeated minor traumas. This, he claims, is frequently seen in artillerymen jumping off and on caissons and in ice skaters due to strain. In the femoral shaft it is his belief that it is due to running in a crouched position or due to the strain of marching with full field pack, with the added factor of the rotary mechanism of the hip joint and the action of the hip muscles.

Wilhelm, in 1940, attributed the pubic fracture to the antagonistic action of the abductors and adductors of the hip in forced and long marches.

The author agrees with Camp and McCullough and Hamilton and Finklestein that march fracture of the lower extremity and pelvis is merely the response of the weight-bearing skeletal frame to continuous overstrain. The exact mechanism for the strain, fatigue, stress, or march fracture is unknown. For example, no explanation has been offered for the characteristic predilection of the site of these fractures. Tibias are usually fractured about three inches distal to the joint line; fibulas generally fracture in the upper third or at the lower end; femora are usually involved about three inches above the joint line or at the neck. It is the writer's belief that just as in metatarsal march fractures, in which fatigue of the

peroneus longus and tibialis posticus is an important etiological factor, so the fatigue or imbalance of muscles in the long bones of the extremities and pelvis is an important causative factor.

MARCH FRACTURES OF THE TIBIA

March fractures of the tibia are the most common of all march fractures of the lower extremity and pelvis except metatarsal march fractures.

Clinical Features. The patient is usually a well developed male in good general health. In six march fractures of the tibia, three occurred in trainees eighteen years of age and three in trainees nineteen years of age. The periods of complaint of pain in the leg before the patients were hospitalized were seventy days, forty-five days, three cases of thirty days, and one of fourteen days, respectively. The length of military service in these patients was two months in one case, three months in two cases, and four months in three cases. The right and left tibias were involved in three cases each. Early in the history of the case there is generally vague pain, chiefly referred to the knee with muscle tenderness, stiffness, and bone tenderness in the upper third of the medial aspect. Later there is swelling with pitting edema and some increased heat and rubor. All motions of the knee joint are painless. Weight-bearing increases pain. In some cases the pain may be severe enough to disturb the soldier's sleep.

X-ray may be negative in the early stages. Later there is commonly some periosteal thickening on the medial and posterior aspect, at the junction of the upper and middle thirds of the tibia. The fracture then tends to spread thoroughout the diameter of the bone as a crack in ice would spread. The callus becomes greater in amount, but is never very excessive. In older cases the x-ray shows a zone of increased density in the area of fracture. There is usually no displacement. The fracture of the tibia may look insignificant and the patient may be returned to duty prematurely. This happened in

Case IV. This soldier was admitted to the hospital January 31, 1944, with x-ray evidence of periosteal thickening without fracture line. He was placed on a non-weight bearing regimé until March 5, 1944. During the absence on leave of the author, a subordinate medical officer permitted this patient to join the reconditioning program. While playing ball the soldier ran and fractured the tibia and fibula. The resultant fracture showed angulation, requiring closed reduction and the application of a cast.

Treatment. Complete bed rest without weight bearing is permitted in cooperative patients. These "ice crack" fractures show no tendency to displacement if weight bearing is not permitted. This non-weight-bearing regimé is carried out for eight to twelve weeks, after which rehabilitation is undertaken. Physiotherapy, dry heat, and massage are prescribed, and active and passive exercises are encouraged. It is the writer's belief that this form of treatment is preferable to plaster immobilization, as there is no problem of rehabilitating a stiffened knee or ankle, due to the fact that motion in these joints is encouraged early. There is also less atrophy of disuse in the muscles of the limb.

REPORTS

CASE 1. The patient, age nineteen, a farmer in civilian life, stated that he developed a slight ache in the knees after four or five marches, and had no other complaint until he went on a forced march the day before admission which caused pain in the knee, leg and ankle which was severe enough to disturb his sleep that night. On examination, the soldier was a well nourished young adult, not appearing acutely ill, but walking with a slight limp. Complete physical examination was essentially negative except for increased heat over the middle of the right tibia and tenderness, most marked in the region of the upper and middle thirds. X-rays taken on April 3rd showed no evidence of march fracture. On April 10, 1944, there was slight subperiosteal calcification along the posterior and medial aspect of the upper

third of the right tibial shaft suggesting a march fracture. A march fracture was suggested. On April 18th, the roentgenologist reported. "The

complaint he had made a number of marches, each of which caused the pain to increase. Examination was negative except for slight

FIG. 1. Case 1, march fracture, right tibia.

subperiosteal calcification of the upper shaft of the tibia has increased in amount in the past week. No definite fracture line is evident. The appearance, however, suggests a march fracture." On June 7, 1944, the x-ray report read, "There is early bony callus at the site of fracture of the upper tibial shaft." (Fig. 1.)

CASE II. This patient, age eighteen, a former office boy, entered the hospital with the complaint of pain in the left knee. He stated that about a month previously, while on a forced march, he developed pain in this region. This pain was referred to the ankle and was increased by carrying a pack. At first he paid little attention to the pain, but as it became gradually worse he reported to the dispensary. Since the initial appearance of his

swelling on the medial aspect of the upper third of the left tibia with point tenderness in this area. X-ray showed subperiosteal calcification of the posterior and medial aspect of the upper shaft of the left tibia. No definite fracture was seen, but there was a zone of increased density through the shaft at this point. The diagnosis was march fracture of the tibia. (Fig. 2.)

CASE III. The patient, age nineteen, a former farmer, inducted into the army on September 30, 1943, stated that on December 27, 1943, while marching back from a night problem, he developed pain in his left knee and in the upper third of the lower leg. He reported to the dispensary two days later and was given a liniment and returned to duty. On January 3,

1944, while in the field taking combat training, the pain became so severe that he was unable to continue. On January 8th, he was hospi-

tion of the upper and middle thirds of the left tibia. (Fig. 4.) On March 4th the soldier was transferred to the reconditioning ward. Two

FIG. 2. Case II, march fracture, left tibia.

talized. On examination there was marked tenderness about three inches below the joint line over the left tibia with some localized rubor and tenderness. X-ray showed a break through the cortex of the left tibia three inches below the articular surface. Very slight callus was present. On January 31st the recheck x-ray showed moderate callus present. This patient was treated with bed rest and local heat for pain, and after four or five days he had no further complaint. (Fig. 3.)

CASE IV. The patient, nineteen years of age, a truck driver in civilian life, stated that on January 1, 1944, while on a fourteen-mile forced march he noted sharp pain in the upper third of the left leg. This area was tender to touch. The pain became severe, but he continued his march. The following day he went on another hike, but had to fall out because of the severity of the pain. He was sent back to the barracks where he did light duty for about two weeks. As the condition became worse, he was sent to the hospital on January 28th for x-ray and was hospitalized on January 31st. Examination revealed no swelling, but there was marked point tenderness over the medial aspect of the upper third of the left tibia. X-ray showed subperiosteal thickening of the medial and posterior aspect at the junc-

days later, while playing ball, he ran and his left leg gave way. There was some deformity and swelling in the region of the old march fracture. An x-ray revealed a complete, simple fracture of the left tibia through the march fracture site and also a fracture of the fibula. (Fig. 5.) The tibia was manipulated and immobilized in a plaster of paris cast, with the fracture in good position.

CASE V. The patient, eighteen years old, a musician in civilian life, was inducted into the army July 24, 1943, and stated that after a forced march in October he developed pain in the right leg. This pain was not very severe in character and so he did not report on sick call. Seventy days later, while on bivouac, pain recurred. The dispensary officer sent him to the hospital for x-ray on December 22nd. The x-ray revealed subperiosteal thickening along the inner and posterior aspect of the shaft of the tibia; no fracture line was visible. On examination there was slight swelling and tenderness over the middle third of the shaft of the tibia. Routine blood and urine examinations were negative. On a regimé of bed rest and local heat the soldier made an uneventful recovery, and at no time demonstrated complete fracture. The x-ray report of March 6th was as follows: "Right leg, there is a thickening of the cortex

along the inner and posterior aspect of the shaft of the tibia about six inches above the ankle joint, the result of an old well healed march fracture."
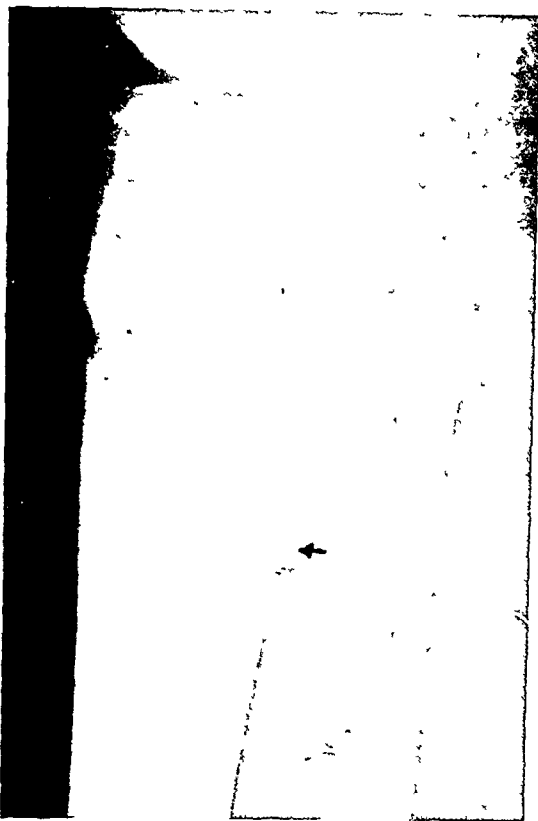
FIG. 3. Case III, march fracture, left tibia.

Comment. Although the fracture in this case was not in the typical location for a march fracture of the tibia, and although no fracture line with condensation of bone developed, I believe this man had a march fracture of the tibia, but due to the bed rest regimé and the removal of weight bearing, the process was aborted.

CASE VI. This soldier, age eighteen, while running the obstacle course on January 22, 1944, experienced dull pain in the upper third of the right leg. That night he noticed sharp pain in the leg, and the anterior upper third became swollen and tender. The following morning he reported to the dispensary and was given a liniment to rub on the leg, but the pain persisted. His leg was painful on walking, but after four weeks the pain had almost completely subsided. The patient noted, however, that if he stood on his right leg and turned to the right, he would again have pain in the upper third of the leg. He also noted that walking over

uneven terrain would cause distress. Two weeks prior to hospitalization the condition became more severe and he again went to the dispensary. This time he was sent to the hospital for x-ray, but was returned to full duty. On March 6th, while standing on the combat range talking to a fellow soldier, he was given a shove and experienced sharp pain in the right leg. This was so severe that he was hospitalized. Complete physical examination was negative except for diffuse swelling on the anterior and medial surfaces of the upper third of the right leg. There was increased heat and marked point tenderness three inches below the joint line. X-ray taken on March 8th revealed a march fracture through the shaft of the tibia about three inches below the knee joint with a moderate amount of callus at the fracture site. With bed rest the pain subsided rapidly, and the soldier made an uneventful recovery without disability.

MARCH FRACTURE OF THE FIBULA

One case of march fracture of the fibula was encountered. This fracture has a predilection for two areas, one in the upper third of the fibula and the other just above the tibiofibular joint. The case the upper third of the fibula and the other just above the tibiofibular joint. The case described by Weaver and Francisco was undoubtedly one of this type. Hamilton and Finklestein described a march fracture of the lower end of the fibula occurring bilaterally.

CASE VII. This soldier, age nineteen, a former switchman, complained of pain in the left lower leg for about two weeks prior to admission to the hospital. It was characterized by cramping of the muscles of the leg and foot. The soldier denied any injury to the leg. He had completed ten weeks of his seventeen-week basic training cycle. At no time had he ever fallen out of a march. Long or forced marches increased the pain. Two days prior to hospitalization the soldier was not able to stand on his foot on getting out of bed and required help to walk to the dispensary. Physical examination showed a tall, robust, young male in no acute pain or distress. The left leg was swollen and tender and was a half inch greater in circumference than the right leg at the level of the

calf muscles. There was tenderness on palpation but no edema. The x-ray report of April 7, 1944, read: "There is a small area of subperiosteal calcification along the medial

MARCH FRACTURES OF THE FEMUR

March fractures of the femur occur at two common sites: the neck, and the

FIG. 4. Case IV, march fracture, left tibia.

aspect of the left shaft of the fibula. This change is also seen posteriorly and to a lesser degree on the lateral aspect." The roentgenologist at that time stated, "This may represent an early march fracture, although the location is somewhat against it." On April 18th the x-ray report read, "There is a well defined hairline fracture through the mid-shaft of the fibula with bone condensation along the fracture line and with considerable callus at this site. The appearance is that of a march fracture." The report of May 11, 1944, stated, "The fracture line is not visible at this examination, but there is an increase in the callus about the march fracture of the mid-fibula." (Fig. 6.) With bed rest and without immobilization the pain and swelling subsided quickly, and an uneventful recovery was made, and the soldier was discharged to duty.

shaft, about three inches above the joint line. Two cases are herein reported, one involving the neck of the right femur in a thirty-one-year-old soldier, and one involving the lower third of the right femur in an eighteen-year-old soldier. The history is usually of an insidious character, frequently overlooked by medical officers who are not acutely aware of this condition. The period of time between the initial complaint and hospitalization was three weeks and one month, respectively.

Treatment. Fractures of the lower end of the femur are treated by bed rest and the avoidance of weight bearing, as these "ice crack" fractures show no tendency to displacement. This regimé is more satis-

factory because rehabilitation is greatly facilitated by the lack of stiffness of the joints and the absence of atrophy of disuse of the muscles.

FIG. 5. Case IV, fracture through site of march fracture.

In fractures of the neck of the femur the application of a plaster double spica cast is indicated, as there is a tendency to coxa vara deformity. Branch reported the use of a three-flanged nail in one of his cases and the necessity for a high intertrochanteric osteotomy for a case of non-union.

CASE VIII. This soldier, age eighteen, stated that one month prior to hospitalization he began to have soreness of the muscles above the right knee. He reported to the dispensary on one occasion and was told to apply hot towels. This gave no relief. The pain seemed to radiate down into the lower part of his leg. He fell out of none of his marches prior to this complaint. On December 15, 1943, he started on a forced march, but had to fall out because of pain. He again reported to the dispensary and was sent to the hospital for x-ray. That same day he made a fifteen-mile hike. He could hardly make it because of the severe pain. On December 20th he went through the infiltration course and stayed on duty until he was ad-

mitted to the hospital. The x-ray showed a typical march fracture about three inches proximal to the joint line with condensation along the fracture site. (Fig. 7.)

CASE IX. This soldier, age thirty-one, had been a lumber camp worker. He was inducted August 10, 1943. Three weeks prior to hospitalization this soldier began to have severe pain in the right hip. There was no history of injury. The following day he reported to the dispensary but was sent back to duty. The next day he reported on sick call again, was placed on quarters status for two days, and was again sent back to duty. Lying down would relieve the pain, but on putting weight on the leg, the pain was severe. As he could not do full duty, he was given light duty. On December 22, 1943, an x-ray of the hip was made and the soldier was admitted to the hospital. The x-ray showed a fracture of the neck of the femur one-half inch above the intertrochanteric line with the fragments in good position. (Fig. 8.) On January 26th a double spica cast was applied, with the leg in abduction. On February 23, 1944, a moderate amount of bony healing had taken place, but there was slight coxa vara present. After eight weeks in the cast, it was bivalved and the posterior half was used at night and physiotherapy was instituted. No further deformity in the region of the fracture occurred, and the soldier made an uneventful recovery.

MARCH FRACTURES OF THE PELVIS

Three cases of march fractures of the pelvis are herein recorded. These cases occurred in soldiers twenty-three, thirty-four, and thirty-six years of age, respectively. The periods that elapsed between initial complaint and hospitalization were seven weeks in one case, and six weeks each in the remaining two cases. This fracture has a predilection for the inferior ramus of the pubis. The early x-ray shows characteristic "fluffy" callus which may exhibit cystic areas, giving rise to the appearance of a bone tumor. There is no tendency for the fragments to displace. The treatment consists of bed rest until the spasm of the adductor muscle group subsides, followed by limited activity for a period of two months before returning the soldier to full duty. As the discomfort

after a short period of bed rest is minimal, soldiers are placed on the reconditioning program after two or three weeks.

soreness, stiffness, and pain in the left groin. The day before hospitalization this soldier had made a twenty-mile hike. This march was ac-

FIG. 6. Case VII, march fracture, left fibula.

FIG. 7. Case VIII, march fracture, lower end of right femur.

CASE X. This soldier, age thirty-four, was inducted into the army January 13, 1944. He had been a meat cutter. He complained of pain in the left groin, and stated that about six weeks prior to hospitalization he developed

companied by marked, but not unbearable pain. When he reported to the dispensary the diagnosis of adductor myositis was made, and he was placed on light duty. As a result, the pain subsided. At the time of hospitalization

FIG. 8. Case IX, march fracture, neck of femur, right.
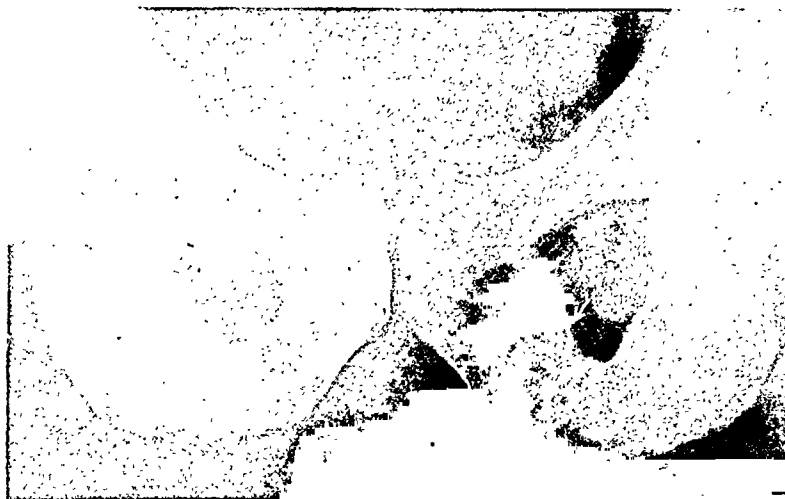

FIG. 9. Case XI, march fracture, right pelvis.
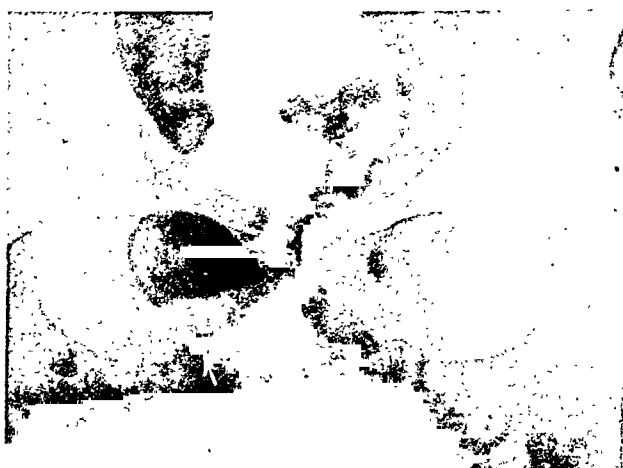
FIG. 10. Case XII, march fracture, right pelvis.

he was in his fourteenth week of his seventeen-week training cycle. The soldier was unable to recall any specific incident that might have caused the above complaint. Examination was essentially negative except for some tenderness over the pubic ramus. There was no muscle spasm, and all motions of the left hip were normal. X-ray showed a fracture of the inferior ramus of the pubis with a faint band of increased density throughout the bone. After two weeks' bed rest the soldier had no further complaint and was sent to the reconditioning ward and made an uneventful recovery.

CASE XI. A twenty-three-year-old soldier, a soda fountain attendant in civilian life, complained of pain in the right groin. This occurred while running over the obstacle course six weeks prior to hospitalization. Pain was aggravated by walking and jumping. At the time of injury he was in the fifteenth week of his seventeen-week training cycle and had been able to make all his hikes and marches. Physical examination was essentially negative. He was a well developed male in no acute pain and had localized tenderness over the right pubic bone, with some muscle spasm in the adductor group. All motions of the right hip were free and painless. X-ray of May 12, 1944, revealed a fracture through the inferior ramus of the pubis with a small amount of callus at the fracture site. (Fig. 9.)

CASE XII. A thirty-six-year-old soldier, inducted into the army November 26, 1943, was a waiter in civilian life. He stated that on or about February 1, 1944, while digging a fox hole, he developed pain in the right groin. This was not severe, and he was able to complete his task. For the next two weeks he continued to train with his company. The pain became more intense daily, and when he was unable to go over the obstacle course, he was told to report to the dispensary. At the time of injury this soldier was in the eleventh week of his training cycle. Physical examination revealed a small, well developed male, in no acute pain. There was some muscle spasm in the adductor group; all motions of the hip were normal except adduction of the thigh, which was painful. X-rays on March 10, 1944, revealed an early march fracture through the junction of the right inferior ramus of the pubis and ischium with a slight amount of callus at the fracture site. (Fig. 10.) On April 4th, there was a moderate amount of callus. After three weeks'

bed rest, the soldier was placed on the reconditioning program and made an uneventful recovery.

SUMMARY

1. March or "fatigue" fracture is primarily an occupational disease associated with military training.

2. Because of the insidious nature of the disease, many cases of march fracture are overlooked by the uninitiated.

3. Etiology is obscure, but the author believes, as in cases of march fracture of the metatarsals, that it is due to muscle fatigue or muscle imbalance.

4. March fractures occur in specific areas of predilection.

5. X-ray appearance is that of an "ice crack" fracture.

6. Displacement of fragments is unusual except in the case of fracture of the neck of the femur, where, if the fracture is not protected from weight bearing, coxa vara commonly occurs.

7. March fractures, even if incomplete and not of striking x-ray appearance, must be treated with great respect, and too early weight bearing should be prohibited.

8. Ideal treatment of march fractures of lower extremity and pelvis is bed rest and prohibition of early weight bearing. In fractures of the neck of the femur, immobilization is indicated.

9. No case of delayed or non-union was encountered.

10. In 10,953 orthopedic cases seen in a period of nine months at an Army Station Hospital, twelve cases of march fracture of lower extremity and pelvis, excluding metatarsal march fractures, were encountered.

11. Case histories of six march fractures of the tibia, one of the fibula, two of the femur, and three of the pelvis were reported.

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PENICILLIN THERAPY AS AN ADJUNCT TO GENITOURINARY SURGERY*

REPORT OF ELEVEN CASES

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IN surgical interventions on the genitourinary organs control of infection is of the utmost importance. A successful outcome depends not only upon judicious choice, well timed application and skillful execution of the operative procedure, but also upon minimizing infection. Penicillin offers us a potent antibiotic which has proven far superior to the other chemotherapeutic agents now at our command. We have employed it in a sufficient number of surgical cases to justify our opinion that it is a valuable adjunct in the prophylaxis and treatment of infection. It destroys susceptible organisms invading the genitourinary tract, general circulation and operative wounds. The many cases of venereal infection which responded rapidly to penicillin therapy will not be discussed in this communication, because surgical intervention was not a part of their treatment.

Until recently, in civil practice the availability of penicillin has been limited. However, we have been able to secure an adequate quantity for use as an adjunct to the surgical treatment of hypertrophy of the prostate, perinephritic abscess and cortical abscess formation of the kidney. We have also employed it for the relief of acute exacerbations of chronic pyelonephritis, attacks of secondary infection associated with tuberculosis of an acquired solitary kidney, and encrusted cystitis associated with bladder diverticulum. In our hands it has been very effective in the preliminary management of patients pre-senting overwhelming infection of the genitourinary organs for whom operation was contemplated. Lately, the compound has become more plentiful, and we are employing it in a greater number of operative cases as a prophylactic measure against infection. Penicillin is equally valuable as a curative agent when infection has developed after operation. The material has the advantage of being nontoxic and rapid in action; in the aged prostatic who is usually intolerant to sulfatherapy, it is often a life-saving measure. Its importance is enhanced by its bacteriolytic effect on staphylococci, which have proven refractory to sulfatherapy. Although it is a powerful weapon in combating infections of the genitourinary organs, it should be considered only in conjunction with adequate surgical intervention such as drainage of pus and operation for relief of encapsulated infection.

CASE REPORTS

CASE I. No. 107402. R. D., aged eighty-four, entered St. Mary's Hospital, August 13, 1944, for relief of complete urinary retention due to hypertrophy of the prostate. The patient presented coronary disease and advanced urinary infection; the offending organisms were Gram-positive cocci and diplococci and Gram-negative bacilli. Medical supervision was carried out by Dr. S. P. Lucia. On September 13th, suprapubic prostatectomy was performed, and a trilobar gland weighing 140 Gm. was removed. Following operation, mild wound infection and marked psychosis developed. A

total of 3,000,000 units of penicillin was administered by intermittent intragluteal injection. On the day following institution of penicillin therapy, the general well being of the patient was improved and psychic symptoms had disappeared. Wound infection rapidly subsided, and urine gradually cleared; on September 25, culture revealed the presence of only Gram-negative bacilli.

CASE II. No. 123580. M. S., aged seventy-three, entered St. Mary's Hospital, December 16, 1944, for relief of complete retention due to hypertrophy of the prostate. The patient presented marked debility, coronary disease and azotemia. Back pressure on the kidneys was relieved by indwelling catheter drainage for two weeks. On December 29th, a trilobar adenoma weighing 32 Gm. was removed by suprapubic prostatectomy. On December 31st, pneumonia and severe mixed urinary infection developed, accompanied by high fever (104.2°F.). Penicillin therapy was instituted, a total of 3,000,000 units was given intragluteally. Pneumonia rapidly resolved and the urine gradually became clear. On January 2, 1945, suppurative orchiepididymitis appeared, which required drainage. It is interesting to note that in the pus obtained from this abscess only Gram-negative bacilli were recovered.

CASE III. No. 109860X. J. C., aged sixty-five, entered St. Mary's Hospital, December 26, 1944, for relief of complete retention due to collar-type hypertrophy of the prostate. Transurethral resection had been carried out five years previously, resulting in relief of symptoms to the present time. Overwhelming infection due to Streptococcus faecalis and Gram-negative bacilli caused added swelling of the remaining portion of the prostate, blocking the neck of the bladder. Infection was favored by a vesical diverticulum. At time of cystoscopy, January 2, 1945, Gram-positive cocci and diplococci and Gram-negative bacilli were recovered. Penicillin therapy was instituted one week before operation to control infection and prevent dissemination during intervention; a total of 2,000,000 units was given intragluteally. On January 11th, transurethral resection was carried out; the channel formerly made between the trigone and verumontanum was widened. The patient returned home relieved of symptoms of prostatism. A significant observation is that on the day of operation

culture revealed Gram-negative bacilli only; the cocci which were playing an important rôle in this case had been entirely destroyed by preoperative administration of penicillin.

CASE IV. No. 122984. E. C., aged forty-eight, entered St. Mary's Hospital, December 12, 1944, for relief of partial retention (residual urine 150 cc.) due to infected prostatic hypertrophy. Azotemia and advanced coronary disease were present. Medical supervision was carried out by Dr. A. P. Diepenbrock. Before hospitalization, after a long period of preparation by intermittent catheterization and sulfatherapy, transurethral resection was carried out on December 13th. Thirteen days later, overwhelming infection of the urinary tract developed, characterized by febrile reaction, frequency, etc. Offending organisms were Gram-positive cocci, Streptococcus faecalis and Escherichia coli. A total of 2,000,000 units of penicillin was administered intragluteally. Symptoms of prostatism subsided and the urine cleared gradually. The patient is still under medical care for coronary disease.

CASE V. No. 60028. P. P., aged sixty-five, entered French Hospital, January 2, 1945, for relief of complete retention due to hypertrophy of the prostate. Pronounced mixed urinary infection was present, including Trichomonas vaginalis. The urine was so turbid and filled with mucus that it blocked the retention catheter, which had to be changed at frequent intervals. After twenty-five days of preparation by continuous catheter drainage, azotemia was controlled sufficiently to permit operation. Suprapublic prostatectomy was carried out on January 27th, and a trilobar prostate weighing 125 Gm. was extirpated. A few days before, intragluteal penicillin therapy had been instituted for the purpose of controlling infection; 2,400,000 units were given in all. The patient made a smooth convalescence. On February 24th, four weeks after operation, the urine was entirely clear, contained no pus and was negative to culture.

CASE VI. No. 29417. J. J., aged fifty-five, entered Southern Pacific General Hospital, January 19, 1945, for relief of retention due to hypertrophy of the prostate complicated by prostatic calculi. Many years ago, a bladder stone had been removed by cystolithotomy. Patient was a good risk, and presented only mild infection of the urinary tract. After preparation by intermittent catheterization,

suprapubic prostatectomy was carried out on January 31, 1945. Considerable pericystitis was encountered, and collar-type hypertrophy containing stones was found to be quite adherent on enucleation. During operation, the peritoneum was accidentally opened and infected urine flowed into the peritoneal cavity. The tear was closed by suturing it to the bladder wall with interrupted catgut sutures. Penicillin therapy was immediately instituted as a prophylactic measure against infection of the abdominal cavity; a total of 1,000,000 units was given intragluteally. The patient made an uneventful recovery; there were no signs or symptoms of peritonitis.

CASE VII. No. 45449. L. S., aged sixty, entered Southern Pacific General Hospital, February 12, 1944, for relief of complete retention due to hypertrophy of the prostate complicated by bladder stones. The patient presented marked debility, anemia, azotemia and advanced infection of the urinary tract. Back pressure on the kidneys was relieved by indwelling catheter drainage for two and one-half weeks. Intravenous urography revealed advanced hydronephrosis of the left kidney, as well as back pressure changes in the right kidney. Culture prior to operation yielded Escherichia coli. Two transfusions were administered. On February 26th, the trilobar prostate and twenty bladder stones were removed through a suprapubic incision. Intragluteal penicillin therapy had been instituted three days prior to operation, and was continued until 3,000,000 units had been given. In spite of the advanced infection which had been present, the wound healed per primam and the patient, a poor risk indeed, made a good recovery.

CASE VIII. No. 87612. A. H., aged forty-two, entered Southern Pacific General Hospital, December 25, 1944, for relief of advanced infection of the right kidney. On April 21st, a large stone had been removed from this organ by pyelolithotomy. Operation was rendered extremely difficult by the high position of the kidney; this organ was almost entirely intrathoracic. Urologic examination revealed multiple cortical abscesses of the right kidney complicated by perinephritic abscess. Sulfatherapy was given a term of trial with no effect. Two days prior to surgical intervention intragluteal penicillin therapy was instituted with the object of precluding diffusion of infection.

Two million units in all were given. On December 30th, the perinephritic abscess was drained, and the kidney removed by subcapsular nephrectomy. Culture of perinephritic and kidney abscesses revealed Staphylococcus aureus and Escherichia coli. The wound was thoroughly lavaged with saline solution and sprinkled with 4 Gm. of sulfonamide crystals. The patient made an uneventful recovery, temperature returning to normal the second day after operation. The wound, in which a drain had been placed in the upper and lower ends, healed per primam.

CASE IX. No. 85496. R. M., aged forty-five, had repeated admissions to Southern Pacific General Hospital for treatment of tuberculosis of a solitary left kidney and the bladder, accompanied by secondary infection. The patient had undergone right epididymectomy for tuberculosis in 1932, left orchiectomy for tuberculosis in 1939; and right nephrectomy for tuberculosis in 1939. Febrile attacks responded slowly to treatment consisting of dilatation of the ureter, kidney lavage and administration of urinary antiseptics including sulfonamides. At the time of the last attack, November 4, 1944, intramuscular penicillin therapy was instituted in place of sulfatherapy. Symptoms subsided much more rapidly than on previous occasions; furthermore, there has been no recurrence since the administration of 3,000,000 units.

CASE X. No. 84243. B. C., aged fifty-nine, had had several entries into Southern Pacific General Hospital for treatment of recurrent acute episodes of chronic bilateral pyelonephritis. Urologic study in August, 1944, revealed bilateral infected hydronephrosis, ureteral stricture, cystitis and papilloma at the base of the bladder. Offending organisms were Escherichia coli, Gram-positive diplococci and short-chain streptococci. A bladder tumor was destroyed by fulguration. Infection of the kidneys was treated by dilatation of the ureters and kidney lavage, and the patient was placed on several alternate courses of sulfa and mandelic acid therapy. Beginning September 4th, three million units of penicillin were administered intragluteally. Following this, the urine became clearer and the patient greatly improved. Recheck examination on February 26, 1945, showed infection still present in the right kidney. Pyelograms re-

vealed a pressure defect probably due to abscess formation. Surgical drainage, or even nephrectomy, may be necessary in this case. At the time of intervention we propose to employ penicillin in order to prevent dissemination of infection.

CASE XI. No. 88426. W. J., aged sixty-three, entered Southern Pacific General Hospital, February 20, 1945. He was referred by Dr. H. E. Rogers, of El Paso, Texas, for treatment of a bladder diverticulum accompanied by encrusted cystitis. Cystoscopic examination revealed advanced cystitis presenting numerous incrustations and hemorrhagic areas and a large diverticulum of the bladder. Urine was highly alkaline (hydrogen ion concentration 7), and culture revealed Escherichia coli and Staphylococcus aureus. Preoperative intermittent intragluteal penicillin therapy was instituted (2,000,000 units in all), and rapid improvement ensued. The urine cleared, and the patient felt so well that he refused operation. Before discharge from the hospital, recheck cystoscopy showed great improvement in the condition of the bladder; incrustations and hemorrhagic areas had disappeared, and the kidneys were free of infection.

COMMENT

Eleven cases are reported in which penicillin therapy was utilized as an adjunct to genitourinary surgery. Organisms commonly found in infections of the genitourinary organs and of surgical wounds are the various cocci; these often exist in symbiosis with bacilli. In the cases under discussion, organisms destroyed by penicillin were Gram-negative and positive cocci and diplococci, and Gram-positive bacilli; viz. Staphylococcus aureus, Streptococcus faecalis and Trichomonas vaginalis. Pyogens that constantly resisted penicillin therapy were Escherichia coli and other Gram-negative bacilli. However, the compound was highly effective in cases presenting overwhelming mixed infection in which these organisms participated, the urine usually having been rendered sterile at the end of four weeks.

The resistance of bacterial species to penicillin is relative, the different strains exhibiting varying degrees of susceptibility. Perhaps the discouraging reports concerning the therapeutic merit of penicillin in mixed infections will be modified by purer extracts, greater dosages, higher concentrations and more specialized culture methods which will reveal elusive anaerobes and other organisms Perhaps, also, more precise information will be forthcoming concerning that phase of bacterial growth at which the mold exerts its greatest lytic effect. According to Todd, this is the stage at which most rapid multiplication of organisms occurs; delayed growth antagonizes the effect. This would account for the success obtained in the so-called prophylactic attack against penicillin sensitive organisms, and likewise for the therapeutic effectiveness of penicillin in early acute infections (young cultures).

Streptococcus faecalis is an enterococcus, or thermophilic form of non-hemolytic streptococcus,[9] which investigators have been in accord in declaring to be penicillin resistant. Helmholz and Chieh Sung to the contrary inform us that penicillin exerts a bactericidal effect on this organism at a level of 3 Oxford units per cc. of urine. Streptococcus faecalis was identified in two of our cases; postoperative cultures made after introduction of penicillin therapy no longer revealed its presence.

The same researchers doubt the therapeutic value of penicillin in combating Escherichia coli, since it has been shown that this rod is capable of producing an enzyme which destroys the *in vitro* bacteriostatic activity of penicillin.[1] Steiner, in a recent report on the sensitivity of Gram-negative bacilli to *in vitro* penicillin activity, studied six strains of Escherichia coli: one was completely resistant; the other five displayed varying degrees of susceptibility, actually requiring less penicillin for complete inhibition of growth than did Staphylococcus aureus. The result of penicillin therapy in his case, in which Escherichia coli was isolated from free pus in the abdomen due to a ruptured gangrenous appendix, is similar to ours

in Case VII. Escherichia coli was the only organism recovered on routine culture in this debilitated sixty-year-old prostatic who presented advanced urinary infection, bladder stones, left hydronephrosis, back pressure on the right kidney, anemia and azotemia. Indwelling catheterization, blood transfusions and penicillin therapy improved the grave condition of this patient so that prostatectomy could be safely carried out. Escherichia coli was not identified on culture of the wound, and healing occurred per primam. Although culture before operation revealed only Escherichia coli, we believe that other organisms, most likely anaerobic, must have been present which were not isolated by routine methods, and therefore that the action of penicillin in this case was both therapeutic and prophylactic. In our other cases in which Escherichia coli were demonstrated in mixed infections, the action of penicillin was manifestly bacteriostatic, as dissemination of infection failed to take place and the few colonies persisting after operation gradually disappeared.

Recently also, total destruction of the in vitro bactericidal properties of penicillin by refractory strains of staphylococci has been reported, and similar studies are being made on non-staphylococcal organisms.[10] We have considered it sound practice to apply penicillin therapy on the basis of clinical improvement instead of withholding adequate treatment during the time required for bacterial study of the sensitivity of isolated organisms. When more is known of the antigenic action of Staphylococcus and other penicillinase, its addition to routine media may result in obtaining successful cultures while penicillin therapy is being carried out.

The satisfactory outcome in our seven cases of hypertrophy of the prostate is enlightening from several points of view. In addition to presenting complete retention, advanced urinary infection and azotemia, three of these patients, two of whom were senile, had coronary disease and were poor risks, indeed. As complica-tions arose after prostatectomy, penicillin was administered therapeutically. The most remarkable feature in Case I, in which the patient was eighty-four years of age, was the rapid disappearance of marked psychosis which developed after removal of a huge adenoma. Patients belonging to this age group are especially prone to such manifestations following prostatectomy. The etiology is not always clear, and the unfavorable outlook has been a bane to urologic surgeons.[5] Proof of the toxic origin in our case appears to lie in the fact that psychic symptoms had entirely disappeared twenty-four hours after introduction of penicillin therapy. Extensive mixed urinary infection, pneumonia and suppurative orchiepididymitis followed operation in Case II. Response to penicillin therapy of all organisms except Gram-negative bacilli was dramatic; only the latter were recovered from the abscess. In Case IV, massive postoperative mixed urinary infection, including Streptococcus faecalis and Escherichia coli, which developed in spite of a long term of preliminary drainage and sulfatherapy, subsided after penicillin therapy was introduced. The therapeutic merit of penicillin in swiftly excluding the susceptible organisms which dominated the advanced mixed infection in these poor risk cases is indisputable.

In the five remaining surgical cases penicillin therapy was started from two to seven days before operation. We find it extremely significant that when penicillin was administered prior to resection of the obstructing hypertrophic prostate associated with pronounced mixed urinary infection, the only pathogens yielded by culture on the day of operation were Gram-negative bacilli. Certainly, destruction before operation of all other offending organisms contributed greatly to the smooth convalescence and rapid return to health experienced by these elderly prostatics. We are convinced that in Case VI the entrance of infected urine into the abdominal cavity through a peritoneal tear that occurred during suprapubic

prostatectomy, was averted by immediate systemic administration of penicillin. Case VIII, on whom nephrectomy was performed for multiple cortical abscesses of the kidney and drainage established for perinephritic abscess, would not have fared so well without adjuvant penicillin therapy. Staphylococcus aureus and Escherichia coli were recovered from the culture material. Penicillin therapy, started two days preoperatively, succeeded in preventing dissemination of infection. Striking was the return to normal of temperature on the second postoperative day. Doubtless, the synergistic action of systemic penicillin and local sulfonamide therapy[14] served to hasten per primam healing of the wound.

Tubercle bacilli are insusceptible to penicillin therapy; however, associated secondary pyogens may be made to disappear rapidly and often permanently under such a régime, especially if it is used in conjunction with systematic-ureteral dilatation. This combined treatment not only relieved our patient in Case IX of recurrent disabling attacks of secondary infection involving a remaining tuberculous kidney, but in our opinion also prolonged his life. In Case X, chronic bilateral pyelonephritis presenting numerous acute exacerbations existed in poorly draining hydronephrotic kidneys. Organisms recovered were Escherichia coli, Gram-positive diplococci and short-chain streptococci. The picture was rendered still more serious by concomitant vesical neoplasm and cystitis. Other forms of chemotherapy, including sulfonamides and mandelic acid had been utilized; the therapeutic effect of penicillin was far superior to any. When surgical intervention becomes` necessary in order to deal with encapsulated infection of the right kidney, which is suspected in this case, we plan to use systemic penicillin therapy as a prophylactic measure to avoid dissemination of infection and local application to favor wound healing. Penicillin therapy in Case XI resulted in disappearance of encrusted cystitis due to Escherichia coli and Staphylococcus aureus. The well being of the patient was so improved that he refused operation for diverticulum of the bladder.

Administration and Mode of Action. Normally, penicillin is excreted rapidly and in high concentration in the urine. For this reason various means of prolonging its action have been utilized. Diodrast, para-aminohippuric acid, epinephrine and, experimentally, human plasma have been added to the solution; the material has been suspended in beeswax and in peanut oil; and local vasoconstriction has been produced by prolonged chilling of the site of injection, in an effort to reduce the rate of absorption and excretion. Rammelkamp and Keefer showed that in diseased kidneys excretion of penicillin is much slower and plasma concentration is maintained over a longer period than in healthy organs. Defective renal function was present in all our cases, making it unnecessary to use colloid penicillin. Retention of large amounts of the agent maintained constant contact of the mold with infected tissues until body defenses were able to cope with the infection,[4] and doubtless played an important rôle in the striking response obtained in these seriously ill patients.

The continuous intramuscular[6] and intravenous[2] infusion technics are advocated by those who seek to maintain a more constant therapeutic level in the blood with a minimum quantity of the agent To date, oral administration of penicillin requires two and one-quarter times as great a dose as intramuscular injection.[8] We prefer the intermittent intramuscular method, which has been well tolerated by all our patients. We have used the sodium salt of penicillin, and our experience with it has been entirely satisfactory. As yet, no standard dosage has been established, and the amount given depends upon the individual case. In acute coccal infections such as pyelonephritis, cystitis, suppurative perinephritis, etc., 300,000 to 500,000 units of penicillin usually suffice. In chronic mixed infections, such as prostatitis

and back pressure over a period of years, and in infection developing after intervention, it has been our experience that two to three million units are required in order to obtain relief. In cases of chronic pyelonephritis recurrence is liable to take place. However, a single course of therapy is usually sufficient to control the attack, although it may become necessary to subject the patient to similar courses later. Each of our patients received 20,000 units at four-hour intervals; the minimum total amount administered was 1,000,000 and the maximum 3,000,000 units. Penicillin fastness was not encountered by us; it is well, however, to give a large initial dose, —especially when the offending organism is a Staphylococcus. No untoward reactions were observed. One outstanding advantage of penicillin over sulfatherapy is that it produces no ill effects on the kidney, such as mechanical blockage of the tubules by concretions and toxic nephrosis.

Prophylactic Use. Two types of patients presenting themselves for operation on the genitourinary organs are encountered: one in which slight or no infection exists, the other in which advanced mixed infection is present. In spite of rigid asepsis and antisepsis, infection is occasionally responsible for an unfavorable outcome. An instance comes to mind in which the superior infected pole of a kidney containing stones was resected. Subsequent overwhelming infection of the remainder of the kidney demanded nephrectomy. Had it been possible at that time to employ penicillin prophylactically, the kidney might have been spared. In the aged debilitated prostatic who is prone to infection and in whose case sulfonamides can rarely be utilized because they are so poorly tolerated, the preoperative use of penicillin will often prevent infection and start a poor risk case on a rapid return to health. It should be administered before intervention for the relief of renal cortical abscesses and perinephritic abscess. Usually, coccal organisms predominate in

such cases; these are penicillin susceptible. In all subjects presenting mixed infection, it is valuable in excluding sensitive bacterial strains, thus preventing dissemination of infection. In some cases, in which only Gram-negative bacilli are recovered before operation, offending cocci are overlooked because of inadequate culture methods. In them, as in our Case VII, prompt administration of penicillin is judicious, as it may exert a therapeutic as well as a prophylactic action.

Therapeutic Use. Penicillin is the ideal chemotherapeutic agent for the aged prostatic in whom infection has developed after operation. It may prove a life-saving measure in the presence of mixed infection following any intervention on the genitourinary organs. Dramatic response has been reported when penicillin therapy was instituted after spillage of the contents of an infected renal cyst;[3] however, prophylactic administration in this type of case would be particularly advantageous. In dealing with chronic infection of the urinary tract, one should not rely on chemotherapy alone; it does not supplant operation for drainage or removal of encapsulated infection. When the kidney is infected, the importance of establishing proper drainage cannot be overstressed, and is a basic principle to which every conscientious urologist should adhere. Urethral strictures and obstructions at the bladder neck should be relieved by dilatation or operative intervention. The poorly draining, ptotic kidney should be supported by an adequate belt or permanently fixed by nephropexy,[11] obstructing kidney and ureteral stones should be removed, etc. Of extreme importance is the establishment of adequate kidney drainage by regular progressive dilatation of strictures of the ureter. Ureteral stricture and ptotic kidney are conditions which are more common than one is led to believe. Ureteral dilatation is particularly indicated in patients nephrectomized for tuberculosis, in whom stricture of the intramural portion of the remaining ureter is usually present,

favoring back pressure, secondary infection and even tuberculosis.

Local Use. The wider use of *penicillin* in operative wounds offers great promise. For the past five years it has been our custom to carry out thorough lavage of all genitourinary wounds with physiologic salt solution, followed by introduction of 2 to 4 Gm. of sulfonamide crystals. There is no question that a less number of wounds in our kidney and prostatic patients broke down following this prophylactic measure.[12] Now that a greater quantity of penicillin is available, so that it is no longer necessary to reserve it for grave cases only, we propose to employ this more efficient material in place of sulfonamide crystals. Infection of most surgical wounds is due to an offending coccus; therefore, combined local and systemic therapy may be expected to elicit rapid healing.

SUMMARY

Penicillin is a powerful antibiotic which is of great value as an adjunct to surgical intervention on the genitourinary organs. It does not supplant operation for drainage or removal of encapsulated infection.

Penicillin sensitive organisms present in infections of the genitourinary organs and surgical wounds are Gram-positive and Gram-negative cocci and diplococci, Gram-positive bacilli and certain strains of Gram-negative bacilli. Inadequate present day culture methods frequently fail to reveal offending anaerobes. Mixed infections are benefited by rapid destruction of susceptible organisms.

Prophylactic use of penicillin materially aids in the prevention and control of infection. In cases of perinephritic abscess, kidney cortical abscess and infected renal cyst, it prevents dissemination of infection. In the aged prostatic, who does not tolerate sulfatherapy, it is an ideal antibacterial agent.

Therapeutic use of penicillin readily controls acute infection; 300,000 to 500,000 units usually suffice. In chronic mixed infections response is slower, and two to three million units are usually necessary to afford relief.

Systemic administration of penicillin combined with local application in wounds favors prompt healing and smooth convalescence.

Eleven cases* are reported in which penicillin was used as an adjunct to genitourinary surgery. Eight were poor surgical risks and presented overwhelming mixed urinary infection. Penicillin therapy, in-

* Since submitting this article we have been able to use penicillin copiously and to observe its beneficial effects in an increasingly great number of cases. In addition to those reported in my communication, I have now employed it in conjunction with genitourinary surgery in ninety-five cases.

	Southern Pacific Hospital	St. Mary's Hospital
Suprapubic prostatectomy (including vasectomy)	12	9
Transurethral resection (including vasectomy)	1	11
Nephrectomy	2	7
Nephroureterectomy		2
Ureterectomy		1
Nephropexy	2	17
Nephrolithotomy and partial resection of kidney	1	
Orchiectomy	4	3
Orchidopexy		2
Exploration of kidney and ureter		1
Regional resection of bladder for carcinoma	1	
Cystolithotomy	2	
Nephrolithotomy		3
Repair of hydrocele	2	3
Repair of spermatocele and varicocele		2
Incision and drainage of kidney wound	1	
Nephrolysis, ureterolysis, renal sympathectomy, resection of aberrant vessel		2
Renal sympathectomy		1
Ureterolithotomy	1	
Ventral hernioplasty (postoperative bladder operation)		1
Excision of penis		1
	29	66
Total		95

All patients received 20,000 units of penicillin intramuscularly at four-hour intervals until a total of one to five million units had been given, and the wound was lavaged with 25 per cent penicillin in isotonic saline solution. In all, the urine cleared rapidly and convalescence was shortened. We observed prompt wound healing in all but one patient, which manifested a reaction to catgut.

stituted prophylactically in six and thera-
peutically in five, controlled infection and
hastened return to health in all. In this
group of cases it has surpassed any
other form of chemotherapeusis formerly
employed.

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THE CRITICALLY BURNED PATIENT

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ALTHOUGH the literature on burns *per se* is both exhaustive and exhausting, the strategy for the individual patient has been neglected in the emphasis on the tactics necessary to attack the various phases of the injury. The earnest physician who seeks practical advice to meet an immediate demand will find himself confronted with abundant, confusing, and sometimes contradictory references in current literature, and with obsolescent technics in standard texts.

This paper presents a practical clinical outline for the overall management of the critically burned patient, using technics which have been found to be effective in both military and civil practice. No comprehensive review of the literature has been attempted, but pertinent references will be given in the discussion of the various stages of treatment.

On the basis of the excellent clinical and research work of the past few years, accelerated by the war and by experience in civilian disasters, certain immediate routines have been evolved, including relief of pain, débridement, use of plasma and other supportive fluids, sulfonamide applications, pressure dressings and immobilization. The ensuing stages, which may include shock, toxemia, sepsis, granulation, and need for coverage with free grafts, are recognized. The physiology and pathology of these stages are being studied, but many questions are still unanswered. The mechanism of death from severe burns in any stage is still undefined, although contributing factors have been established.

Many severely burned patients fail to survive the stages of shock or toxemia. Many that are carried through these stormy stages live for a month or two but continue to fail through the stage of sepsis, with its infected granulations and accompanying serious anemia, seepage of tissue fluids, and parenchymatous damage. Regardless of theoretical considerations, the physician is confronted with the necessity for management of the critical case, the patient who lives on from hour to hour, from day to day.

Much has been accomplished in reducing immediate mortality from burns. Perhaps the most important field for reducing the casualty list still further lies in foreseeing and circumventing the various critical sequelae to the immediate trauma. The fluctuations in the course of such cases must not merely be met; they must be anticipated. Every therapeutic aid must be employed to reinforce the struggle of the bodily mechanisms against toxemia and infection; no less important is the avoidance of any agent which might impair those mechanisms.

Maintenance of the patient's bodily equilibria is the primary need. All necessary physical measures should be carried out rapidly and gently, to prevent further trauma and to facilitate concentration of attention on supportive therapy. The patient does not die from the burn trauma itself; he dies either as a result of intractable circulatory imbalance and its sequelae, or as a consequence of inappropriate treatment, local and systemic.

We must make certain that the tactics on one salient contribute to the overall strategy and do not conflict with tactics directed toward another salient.

DIAGNOSIS OF "CRITICAL STATE"

Treatment should be instituted *before* critical symptoms and signs appear, not afterward. This means that if there is any

doubt as to the exact degree of severity the patient should be considered to be critically burned. Age and general condition are, of course, also important factors. A patient whose burns are truly critical may show only an extensive hyperemia and small areas of charred skin on first inspection, so that it is not possible to determine the degree of the burn immediately. Furthermore, as will be discussed later, the degree of the burn may be severe more as a result of improper treatment than of initial trauma.

If 25 per cent or more of the body area is involved and the patient shows signs of previous, present, or impending shock, the "critical" treatment should be instituted at once regardless of any apparent superficiality of the burn.

Cyanosis, unconsciousness, rapid and feeble pulse, are among the well known signs of shock. In burns an important sign may be the condition of the tongue. If it is dark brown and edematous, with an almost charred appearance, it is an infallible indication that the patient is in critical condition. This sign may appear at any time during the first week.

It has been pointed out that in burn cases shock may be present without notable signs.[1] This observation emphasizes the importance of adequate treatment. It is far better to find that more than adequate care has been given to a moderate burn than it is to be confronted with a terminal emergency arising from inadequate treatment of a critical burn.

CONTROL OF PAIN

Relief of pain is of course the initial consideration in any régime. Morphine is used as necessary to achieve it. Up to $\frac{3}{4}$ gr., given in $\frac{1}{4}$ gr. doses, may be necessary in the first hour.

However, it should be remembered that the more rapidly and gently the initial débridement and dressing are carried out, the less need will there be for morphine. A satisfactory medicated pressure dressing is in itself a major anodyne.

It has been pointed out that restlessness and delirium may be mistaken for pain, and that excessive administration of morphine may precipitate shock and terminal crisis; and it was suggested that barbiturates might be utilized to lessen the amount of morphine required. Overuse of the barbiturates, however, might in itself be dangerous, whether in the shock period with its constant threat of anuria or in the later stages; the extensive parenchymatous damage in the toxemic stage would interfere with hepatic destruction or renal excretion of the barbiturate, and would magnify the possibility of toxic accumulation in the system. After the initial period codeine sulfate ($\frac{1}{2}$ gr.) is given hypodermically three times a day and is usually sufficient to control pain.

DÉBRIDEMENT

Débridement should be minimal, and all initial procedures should be carried out rapidly. Opening of blisters, painstaking removal of dead tissue, and vigorous cleansing are contraindicated. A critically burned patient may be past the initial shock upon arrival at the hospital, but the time spent in moving him about, plus the additional trauma of thorough débridement, may throw him into secondary shock. Furthermore, excessive débridement and too frequent change of dressings have been responsible for the conversion of many a second degree burn into one of the third degree. Supportive measures to ward off shock and build up the patient's reserve are the urgent considerations, rather than surgical perfection in débridement. In the average practice, too much time has been given to the burned areas, and too little consideration paid to circulatory imbalance.

The areas should be cleansed lightly and rapidly with white soap and water, rinsed with physiological saline solution, and dried. In some instances, as in industrial accident cases, it may be necessary to use an appropriate detergent to remove

large quantities of grease or other foreign substance in the burned areas.

Even if there has been no contamination with soil, tetanus antitoxin should be given, in the usual prophylactic dosage of 1,500 units, after a preliminary test for sensitivity.

INITIAL DRESSING

The initial dressing should control infection, supply pressure to check capillary dilatation and fluid loss, and prevent inspection and handling. The last item may be the most important. The value of pressure dressings has been firmly established. Various forms of such dressing, and the use of gels, plastics, serum, ointments and other adjuncts, have been advocated, each advocate offering convincing reasons for the superiority of his own particular technic. Such success may frequently be ascribed to the fact that all these methods serve to keep the physician from exposing and handling the injury while it is healing.

In the practice of controlled exfoliation for correction of surface defects of the skin[2] it has been noted that a first degree burn will heal in four to five days if there is no interference; if it is dressed or inspected too frequently it may resolve into a second degree burn. Similarly, a second degree burn will ordinarily heal in from ten to fourteen days, but may be converted to a third degree burn with frequent inspection and change of dressings. It is only in the later stage of granulation of third degree wounds that dressings require frequent change to facilitate the reparative process.

The use of tannic acid and similar surface films on burned areas is fortunately becoming obsolete.[3] The coagulum films serve to protect the area from interference, but invite serious problems when necrotic tissue is present and septic areas are encased. If the film is not water-soluble, its removal is difficult and traumatizing. If it is water-soluble, it does not prevent the escape of tissue fluid. Furthermore,

coagulating agents may produce serious systemic effects; tannic acid has been demonstrated to have a deleterious effect on the hepatic cells.

The use of plaster dressings is praiseworthy from the standpoint of protection and immobilization, but also has the drawback of being difficult to remove. In addition, the odor from such dressings may be offensive and offers an institutional as well as an individual problem.

The simple pressure dressing, using gauze, cotton waste material, and roller bandage, is therefore the method of choice. A moist pack is used because it molds itself to the part covered, and dries to a firm even cast which will not slip. The usual dry pack has a tendency to slide out of place even with the most careful transfixion with bandage and adhesive. The use of the moist pack offers advantages claimed for plaster dressings while retaining those of the usual pressure dressing.

A word of caution against overenthusiastic use of the roller bandage is in order. This is particularly true in burns of the extremities where too zealous application of pressure may result in what might more appropriately be called strangulation. With a moist pack to obviate slipping there should be no temptation to use excessive pressure.

The question of what agent should be used topically before bandaging has been another source of controversy. Simple grease applications for lubrication and protection have the soundest physiological basis. In controlled exfoliation, for example, where no contamination is present, the use of bacteriostatic agents would be redundant. But in most traumatic burns contamination must be reckoned with and local use of sulfonamides is necessary to reduce the possibility of spread of infection. Systemic use of sulfonamide is not recommended at any time in the course of a severe burn. To the difficulty of maintaining and checking therapeutic blood levels may be added the possibility of severe reaction and the dangers of inade-

quate excretion in a patient with widespread parenchymatous damage and renal insufficiency.

The objective, then, is to find a proper vehicle for the sulfonamide—one which, combining water and oil phases, will release the drug in optimal amounts from the dressing to the burned surface. The following preparation is our choice for the purpose:

Petrolatum.............................. 500 cc.
Sorbitol mono-oleate (oil soluble)........... 20 cc.
Sorbitol mono-oleate (water soluble)........ 3 cc.
Sulfathiazole powder...................... 50 Gm.
Distilled water........................... 500 cc.

The petrolatum and the sorbitols are mixed and heat sterilized. The sulfathiazole is sterilized and dissolved in the sterile distilled water. The solution is then emulsified with the petrolatum mixture, with aseptic precautions throughout the process.

A quantity of 3 by 12 inch strips of fine mesh gauze are placed in a sterile porcelain dressing tray. On top of these strips is placed a quantity of the prepared ointment. The tray is then covered and heat treated, below 210°F., just long enough for thorough permeation of the ointment into the gauze. Overheating tends to cause separation of the oil and water phases.

The formula given above is essentially that of Jenkins et al. (the proportion of the water soluble sorbitol is slightly larger), who have published an excellent discussion of the problem of suitable sulfonamide vehicles.[4] The use of the prepared gauze strips, already impregnated with ointment, was devised to make possible a more uniform dressing and to facilitate its application.

The usual water-soluble sulfathiazole ointments are not recommended, since they dry out quickly and cause the dressings to adhere to the burned areas.

The actual dressing is applied as follows: The sterile impregnated strips are applied over the burned areas. Over the strips are applied 4 by 4 inch gauze sponges which have been dipped in physiological saline solution and then expressed. Over these are placed sterile A pads or cotton lint waste. The dressing is held in place with heavy roller gauze bandage and sufficient adhesive tape to assure transfixion. The roller bandage should be applied with reasonable firmness to insure steady even pressure, but should not be drawn too tightly. The use of elastic roller bandage is to be condemned, since the tension it supplies is too great. If the chest or trunk is involved a binder is used for the outer covering.

Once applied, the dressing is left undisturbed for ten to fourteen days, and all measures are directed toward systemic support rather than local care. Frequent re-dressing introduces infection, causes pain, checks normal proliferation of new epidermis or of granulation tissue, and destroys such new tissues as attempt to form despite the excessive handling.

After débridement and dressing, the patient is placed in bed in a slightly elevated position, the limbs also being slightly elevated. The use of the cradle has no place in modern therapy.

Patients are more comfortable with a covering of bed sheets, without blankets. While actual chilling is to be avoided, it is now recognized that heat has no place in the management of shock, frank or incipient. We are dealing with a problem of excessive capillary dilatation, and our efforts are directed toward controlling and reducing it rather than increasing it by such means as heat.

PERIOD OF SHOCK

For the first two to three days the danger of shock is ever present. All therapy is directed toward warding off circulatory failure. In the early stages the parenchymatous organs do not undergo damage as a result of toxemia but rather from the generalized edema and capillary hemorrhages. If the edema is extensive in the brain or lungs early fatality results.

Plasma transfusions should be started at once, and the dosage should be massive. Ten to 20 units (3,000 to 6,000 cc.) should

be given during the first forty-eight hours, the bulk of it during the first twelve hours. This should be supplemented with intravenous or hypodermoclysis of isotonic electrolyte solutions (sodium chloride and sodium bicarbonate), some containing glucose (to furnish 400 Gm. for the first forty-eight hours). Such electrolyte solutions should be used in amounts roughly equal in volume to the amount of plasma used. If the patient is able to take some fluids by mouth, some of the electrolyte solution may be given in this fashion. However, in this paper we are dealing only with the critical case; and the patient in critical condition is ordinarily unable to take and to retain fluids given by mouth during the shock period. Our chief route of fluid administration must be parenteral; and our chief source of fluid must be plasma.

In these cases the reduction in circulating blood volume is so great, and the areas for permanent loss of protein through seepage so large, that only massive substitution therapy can meet the demand. The electrolyte solutions are also needed to replace salt loss and to combat dehydration, anuria, and parenchymatous damage. The suggested dosages of fluid seemed radical at the time the author first found them successful in combating shock in critical cases. It is interesting to note that a recent publication by Harkins et al.[1] under the auspices of the Subcommittee on Shock, outlines a routine of fluid administration which for critical cases would entail even larger volumes. This report is commended to the reader as an excellent summary of modern fluid therapy, with details of preparations of suitable isotonic solutions and formulae for determining the necessary volumes of plasma.

For the first seventy-two hours a close check of the urine is important. The patient is catheterized each eight hours as a routine measure. This is more effective and less trying to the patient than continual efforts to void. A satisfactory urinary output, of course, lessens the necessity for parenteral electrolyte solutions.

Oxygen is an important adjunct in supportive therapy. While there have been many arguments pro and con its value,[5] clinical results have seemed to warrant its routine use in these critical cases. The margin of safety is so narrow that any increment may prove to be life-saving. The critically burned patient is placed in an oxygen tent for the first forty-eight hours, with occasional short rest periods to avoid possible respiratory irritation. The tent rather than the catheter or face mask is used because it is more comfortable for the patient and facilitates nursing care.

Cardiac, respiratory, and circulatory stimulants are numerous and each has its proponents and opponents. No discussion of this subject will be attempted, for such drugs play only a minor rôle at best. Adequate return of blood to the heart and replacement of lost or displaced plasma proteins are the necessities of the body, and if these are provided artificial stimulants will ordinarily be unnecessary.

PERIODS OF TOXEMIA, SEPSIS, AND GRANULATION

With minimal trauma in dressing the wounds, with every precaution to husband the patient's strength and make him as comfortable as possible, and with adequate fluid therapy, the shock period may be safely passed. But vigilance cannot be relaxed during the ensuing weeks.

The period of toxemia follows the period of shock, and is usually over by the time the initial dressing is to be changed. The period of granulation follows until repair is complete. A period of sepsis may be superimposed at any time following the shock period but is usually encountered following the toxemic stage. Sepsis is as a rule the result of improper care or of a delay of many hours between the inception of the burn and the arrival of the patient for treatment.

Plasma ceases to be an important therapeutic agent once the patient has entered the toxemic period. The emphasis now is directed to use of whole blood and a deli-

cate control of electrolyte output and intake.

The initial hemoconcentration is usually gone; but it must be emphasized that not only is the relative number of red cells reduced but also those cells which are circulating are not functionally normal. There has been much discussion of tissue toxins in these stages. It is sometimes forgotten that blood, too, is a tissue, and that the red cell's capacity as an oxygen carrier is quite as susceptible to obscure derangements as is the filtering capacity of a glomerular cell. Whole blood, therefore, is needed in order that the body receive an adequate supply of oxygen. It is required whether the anemia is frank or is masked by dehydration or malfunction of cells present in normal concentrations. Blood is thus given in the toxemic stage chiefly as an oxygen carrier. In the later stages of granulation it is needed to correct hypoproteinemia and secondary anemia.

If at the end of the third day the clinical condition of the patient is not satisfactory, it is advisable to give 500 cc. of whole blood even if the red count is 6 or 7 million. The results are frequently dramatic. It may be pointed out that with such high counts as these, the whole blood transfusion does not actually increase the count but serves rather as a dilution. The important factor, however, is that healthy red cells capable of function be present.

In a frank anemia, larger amounts of whole blood will be necessary, and they must frequently be administered over a period of several days in order to bring the red count up to at least a low normal level. The red count should be carefully watched throughout the course, and whole blood should be used without hesitation whenever anemia threatens. Three to five transfusions of 500 cc. each are usually required each week during the first two weeks, but it may be necessary to give a transfusion daily. Washed red cells may be given as an adjunct in amounts up to 300 to 500 cc. each week. Rh typing should be a routine, since these patients must not

be exposed to any possibility of a transfusion reaction.

Throughout the stages of toxemia and granulation the estimation of the necessary requirements for electrolytes and water is a difficult problem, but one which must be solved. During the early toxemic period the massive tissue edema resulting from the initial shock is being resorbed, but fluid, protein, and salts are seeping from the burned areas. Vomiting may cause fluid and electrolyte loss. As the patient progresses into the stage of granulation, nutritional difficulties and protein loss from the areas may again lead to edema. There must be a continual balancing of these factors of protein, fluid, and electrolytes to avoid both the Scylla of edema and the Charybdis of dehydration. The reader is again referred to the article of Harkins et al. for valuable material on these phases.

When large quantities of whole blood are given it is possible to reduce the amount of salt administered, although glucose and water will still be required. When less blood is needed, electrolyte administration must be increased. So far as possible fluids should be given by mouth; but if adequate intake cannot be maintained, glucose in saline solution must be administered parenterally.

Beginning edema may be signalized by perspiration of the unaffected areas of the skin and by urinary incontinence. If these signs appear the fluid intake should be cut 50 per cent during the following twenty-four hours. Or if any seepage is observed from a site of injection, the fluid intake should be sharply reduced at once.

Dehydration is usually marked by a sudden sharp rise in temperature from base levels, for example, a rise to 104°F. from a consistent 101°F.

The urinary output should be closely checked and listed against the fluid intake. The condition of bed linen and dressings should also be noted and recorded as a check of fluid loss. If the urinary volume drops below 400 cc. in twenty-four hours, a hypodermoclysis of 1000 cc. of isotonic

saline should be given, constant watch being maintained for signs of edema.

Abdominal distention is a common complication in the third or fourth week and even if the percussion note is tympanic it is advisable to catheterize such patients occasionally.

Prevention of edema cannot be accomplished unless adequate protein levels are maintained. Such maintenance is difficult because of the loss of and increased need for nitrogen. Loss of protein from burned surfaces, in the urine, and from toxic alterations of tissue proteins, the increased need for protein for regenerating tissue and red cell proliferation, and the patient's inability to ingest adequate nourishment are all factors in producing the typical hypoproteinemia and negative nitrogen balance.

Plasma is sometimes used as a protein-providing substance, but its relatively small protein content makes it an expensive source. If it is given late in the course, there may be a protein reaction, evidenced usually by minor chills followed by elevation of temperature of two or three degrees for twenty-four hours. When plasma is used two units should be given, for if a reaction appears it will be no more severe with two units than with one.

In critically ill patients in the third to fourth week, with sepsis superimposed on the granulation stage, it is impossible to furnish adequate nourishment parenterally and the patient usually refuses food by mouth. In such cases the nasal catheter must be used for duodenal feeding. It is left in place for forty-eight hours before removal for cleansing.

Protein may be given in such forms as meat extracts, milk, or amino acids. The latter are theoretically ideal, but in practice are difficult to ingest and to retain. Adequate intake of iron and of vitamins, particularly vitamin C, should be maintained.

Because of the parenchymatous damage, and the tendency to anuria and uremia, the use of sulfonamides by mouth is not recommended. As a prophylactic to forestall pulmonary infection and to prevent the spread of sepsis, penicillin is the agent of choice. After the first two weeks, if a septic type of temperature appears or if culture shows a mixed infection of a type accessible to penicillin, 200,000 units are given, divided for administration every three hours, over a twenty-four-hour period.

It is unfortunate that penicillin is not suitable for local therapy in septic cases. Too much is lost in the dressings for it to be effective, and it is also quite irritating and painful when applied to the injured areas.

INSPECTION, DÉBRIDEMENT, AND CARE OF
BURNED AREAS AFTER REMOVAL
OF INITIAL DRESSING

The initial dressings are left intact for ten to fourteen days. There is no rational excuse for inspection during this period. The burned areas are in almost all cases contaminated from the onset, and the surface bacterial count will not be lowered by daily change of dressings in the early stages. Indeed, with the usual hospital technics—use of the general dressings' cart and so on—it will be raised. The necrotic tissue itself probably contributes little "toxic" material to the circulation, certainly not enough to cause a fatality.

Removal of dressings, and all subsequent inspection and re-dressing of the areas, must be carried out under aseptic conditions. While the initial débridement is usually done with proper aseptic technics in the surgery, the ordinary routine for care leaves open many paths of infection. Dressings for burn cases should be made up in individual packages, each containing sufficient material for a dressing, and appropriate instruments.[6] These packages should be sterilized, marked with the patient's name, and be at hand for each inspection, being ordered in advance on the hospital chart. The physician should be properly gowned and masked and the patient draped as for any aseptic procedure. With such precautions the incidence

and severity of septic infections can be greatly reduced.

When the outer layers of the dressing have been removed, the layer next to the wound may be found to be adherent. In such a case it should not be lifted off at once. Instead, a liberal amount of hydrogen peroxide should be poured over the area. In a few moments it will be found that the dressing has loosened and may be gently removed. If a few spots are still adherent, the free dressing is deflected gently from the burned area and addition hydrogen peroxide is poured directly on the junction between the wound and the dressing. This procedure prevents any damage to the denuded areas or to tender new tissues.

The degree of the burn may now be determined. The first degree burn will show hyperemia with complete epithelization. The second degree burn will show the exposed corium with many hair follicles, the appearance being similar to that of the donor site following the removal of a thin sheet of skin for grafting. There will be areas of complete epitheliazation. The third degree burn shows dull white patches, leathery dark brown coagulum, or healthy cherry red granulation surface.

Complete débridement is now carried out. Blisters are opened and loose necrotic tissue is excised. If the area shows no healthy granulation tissue, grease dressings exactly similar to the initial dressing are applied. They are changed every three days, with débridement, until granulation tissue appears. If granulation tissue is present, wet dressings are begun in order to encourage the reparative process. Fine mesh gauze wet with distilled water is used to cover the areas, which are then padded with wet gauze and encased in roller bandage. The dressings may be kept moist by means of Carrel tubes included within them, or may be soaked three or four times a day and kept covered with cellophane or rubber. Sterile water is used for the soakings; in these large areas there is danger of absorption or irritation from solutions of boric acid, magnesium sulfate, salt solutions, and similar substances.

SKIN GRAFTING—USE OF HOMOGRAFTS— NEW TYPE OF STRIP GRAFT

The ideal coverage for a granulating burn surface is conceded to be the autograft. However, these critically burned patients present a difficult problem. In some cases the additional insult produced by the anesthesia and trauma necessary for even minimal autografting would be sufficient to produce fatal results. The poor nutritional state reduces the likelihood for a good "take," yet continuous seepage from large areas defeats all attempts to maintain the nitrogen balance.[7]

In such extremely debilitated patients the use of homografts may be life-saving. Large sheets of skin (thin split grafts) may be removed from donors and placed, without peripheral suturing and without anesthesia, on the burned areas. The usual dry pressure dressings, of gauze sponges or cotton lint waste, are applied. The plasmaheparin agglutination technic may be used if preferred to seal the graft to the area, and the pressure dressing then applied. After five days, the initial dressing is removed and the areas re-dressed. Inspection is carried out every two days thereafter, with change of dressings. Frequent change is necessary in these cases because there is considerable soilage.

Once placed, these homografts furnish immediate and excellent occlusion of the surface; there they will slowly liquefy. It may in some cases be necessary to repeat the process two or three times; but each time the granulation surface will appear cleaner, and healing by scar formation will ensue. The period of homograft coverage may extend from four to six weeks when two or three grafts are applied in succession. If the patient's condition permits, autografting may be done at the end of this time; if not, scar formation is permitted to proceed. Six months or a year later, if the scar is

deforming or produces a vocational handicap, it may be excised and secondary repair may be carried out with autografts.

reckoned with and corrected. Adequate tension and suturing are essential for adequate utilization and "take."

Donor graft shrinks 20 to 30 percent

Donor graft

Site of donor graft.
Exact pattern size of defect.
Full thickness skin graft.
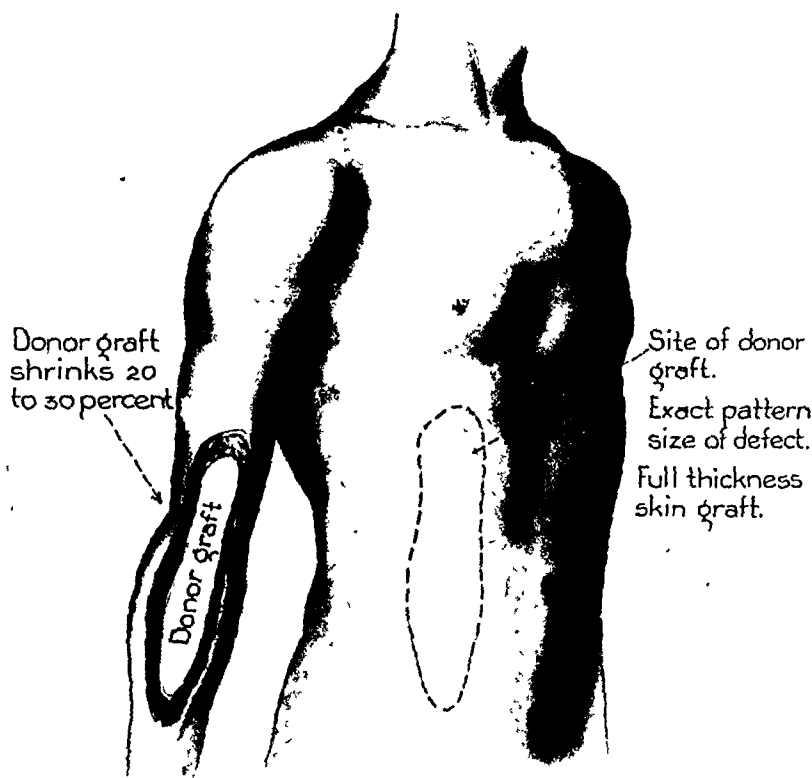
FIG. 1. Contraction of normal skin on removal from donor site.

In removing such homografts from donors, it must be remembered that normal skin will shrink to 60 to 70 per cent of its original size upon removal. Since the donor graft is not peripherally sutured to the site, it is necessary to compensate for this shrinkage by a corresponding increase in the size of the graft. (Fig. 1.)

When the condition of the patient warrants autografting, but the amount of skin available is insufficient for total coverage, the usual procedure is to apply pinch or stamp grafts. However, because of the natural contraction just discussed, such grafts ordinarily cover only 60 to 70 per cent of their potential. Even if a sheet of skin is large enough to furnish coverage for the greater part of the granulation tissue its full benefits are frequently lost because contracture is not

To obtain maximum utilization of the available material, a new type of strip graft has been devised. (Fig. 2.) The strips of skin are cut 1 inch wide and 4 to 8 inches long, according to the size of the raw area to be covered. The strips are sutured at each end to the periphery, under strong tension, and are placed 1 inch apart in parallel rows. Interrupted cotton sutures are placed, 1 inch apart, from strip to strip and from the terminal strips to the periphery. After these sutures are in place, traction is applied at either end by the surgeon and his assistant, and the sutures are tied off. The full normal width of the strips is thus restored, and a complete "take" is assured. Proliferation will take place from the edges of the strips to ensure maximum coverage. The use of strong tension also prevents a patch-like

appearance of the graft after healing, the donor strips taking on the characteristics of the normal skin of the area grafted.

2. During the first forty-eight hours intensive care to support the circulation and ward off shock is the primary con-

2 Graft is sutured back to its normal tension and length and interrupted cotton sutures are placed one inch apart.

3 After sutures are in place traction is applied by surgeon and assistant, pulling grafts to normal size.

1 One drum provides 8 strips 1 in by 4 in, A graft sufficient for a defect 4 in. by 16 in.

Pagett dermatome drum
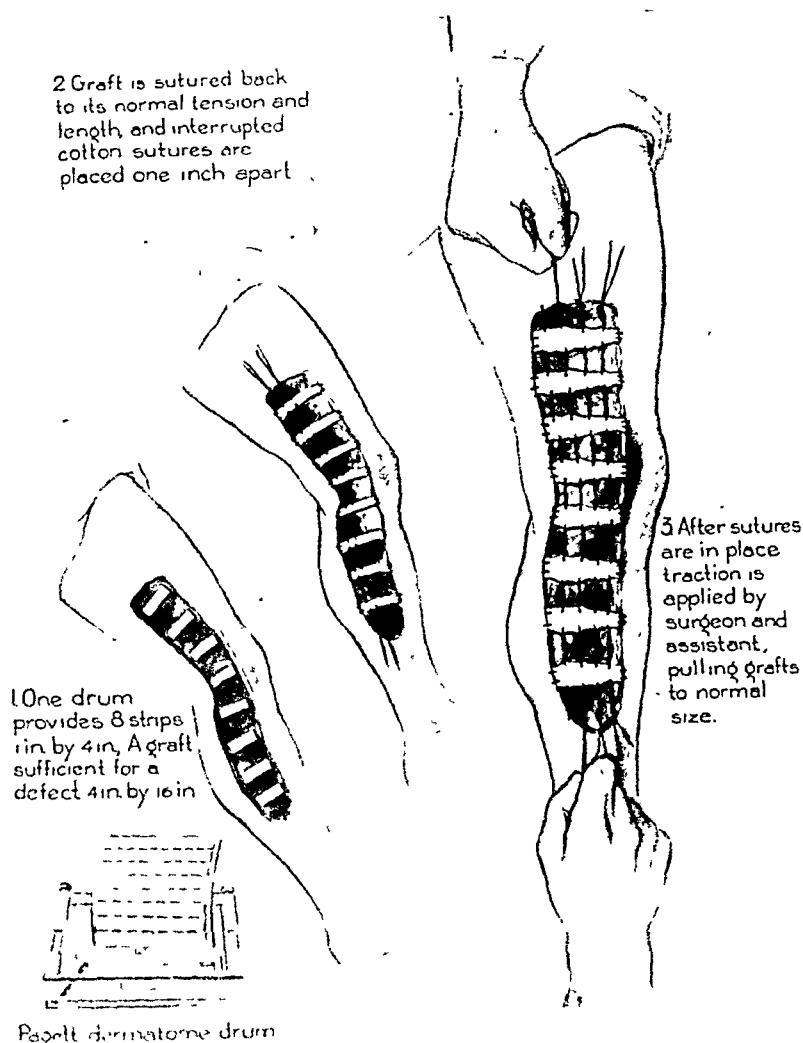
FIG. 2. Technic of preparing and applying strip graft for maximum coverage.

All sutures are specially prepared, previous to the operation, by being immersed in sulfathiazole solution and allowed to dry. They are then sterilized as usual.

Autografting technics, including procedures for after-care, have been given in detail in a previous paper.[5]

SUMMARY

1. Initial care of severe burns should include rapid and minimal débridement and bacteriostatic pressure dressings.

sideration. Massive doses of plasma and adequate electrolyte intake are the chief adjuncts in the treatment of the critically burned patient.

3. Once the period of acute circulatory crisis is passed, the stages of toxemia and of granulation follow, and sepsis may ensue. Adequate use of whole blood transfusions, a delicate balance between edema and dehydration (achieved by proper administration of fluids), and maintenance of nitrogen balance are necessary. Penicillin is used to combat sepsis.

4. The initial dressings must not be disturbed for at least ten days. After that time they should be changed with the aseptic precautions required for surgery.

5. Homografts may be used successfully to ensure temporary skin coverage and preserve life in the critically burned.

6. When the condition of the patient permits some autografting, a new type of strip graft insures maximum utilization of the available graft material.

CONCLUSION

The care of the patient rather than of the affected areas should be the primary concern in the treatment of the critically burned patient.

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THE person in shock should be protected from cold or exposure. Blankets, guarded hot water bottles, a tent or canopy containing superheated air from electric lights or other source should be used.

From "Principles and Practice of Surgery" by W. Wayne Babcock (Lea and Febiger).

THE USE OF A BLOOD-KAOLIN-PENICILLIN PASTE IN THE TREATMENT OF VARICOSE AND TORPID LEG ULCERS

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IN the last few years several methods were published utilizing blood in the therapy of varicose ulcers. Richter advised (1941) the sprinkling of the patient's blood on gauze covering the ulcer. Moorehead and associates described (1943) a laboratory method of the production of a red blood cell concentrate salvaged from the bloodbank. Naide and Meyer (1943) placed 5 cc. of the patient's blood on his ulcer and let it dry there for one-half hour to two hours before dressing. Sheldon and Young of the Mayo Clinic advocated in 1943 the use of dried red blood cells realizing the difficulties in keeping the semiliquid material in contact with the wound. Finally, Murray and Shaar produced (1944) a blood cell paste of the following composition: 250 cc. fresh blood cells type o and 25 cc. of a hexylresorcinol-tragacanth mixture (75 cc. of 1:1000 hexylresorcinol solution and 2.5 Gm. powdered tragacanth).

These authors believe that necessary nutritional elements are supplied by the blood paste to the deficient tissue which has been starved by inadequate circulation. A more important factor, however, seems to be the protective action of the blood, which, after formation of a blood crust, acts as an immobilizing splint under which epithelization takes place undisturbed, imitating the normal process of wound healing.

Considering the requirement of ambulatory treatment of varicose ulcers the writer adopted a simple and time-saving method, whereby the patient's blood, or group o from a bloodbank, if available, was mixed with equal parts of kaolin. To this mixture 1.2 cc. of penicillin standard solution (5000 units per cc.) was added to 10 cc. paste. Originally, ceepryn or tyrothricin was used, but later on was abandoned. Only occasionally where penicillin resisting Gram-negative, saprophytic and paracolon bacilli prevailed ceepryn concentrate (2 drops to 10 cc. paste) was resorted to.

In the office the preparation of the paste could not be carried out under aseptic conditions. However, the addition of penicillin was considered as a safeguard against contamination. Since in all cases the area to which the blood paste was to be applied was primarily infected, it did not seem necessary to use an absolutely sterile paste. Superimposed infection after the use of the paste never occurred.

The paste was applied to the ulcer, and covered with 1 sheet of gauze. A thick layer of talcum powder was spread over the gauze, and the entire leg encased in an Unna's paste boot or an elastoplast bandage. The bandage was changed every five to eight days, and the patient kept ambulatory if possible.

After a few days the paste turned into a grayish-yellow crusty mass adhering partly to the bandage, partly to the skin, especially in areas deprived of epithelium. The crust could easily be removed by water, hydrogen-peroxide and ether. Sometimes a sharp spoon proved to be useful in removing the softened crusts.

Observations made on 19 cases resulted in following conclusions: (1) The blood-kaolin-penicillin (b-k-p) paste was well tolerated by all patients. (2) There was a definite pain-relieving effect noticeable, especially in cases of irritable ulcers. (3) While a drying effect was evident in all ulcerations, a phlogistic action was noted

on chronic eczematous regions leading to exudation and hyperemia. The b-k-p paste should be limited to the ulcerated area only, and kept away from chronic eczematous areas. In spite of the drying effect the ulcerations showed healthy red granulations with normal turgor replacing necrotic membranes after two to nine applications. The epithelium started to grow from the wound margins underneath the crust. (4) The local hemotherapy in varicose and trophic ulcers is not a panacea. Adjunct therapy, such as high and low ligation of the saphenous vein, sclerotherapy, supportive bandages, and bedrest in selected cases is indicated to assure healing.

Case Reports. There were three cases of irritable ulcers, one at the malleolus internus, one over the tibia, and one in the lower third of the leg above the externus malleolus. The ulcers were lying in dense cicatricial areas, and were extremely painful. There was a low grade infection with scant exudation. The condition persisted from three to six months. All three patients received b-k-p paste plus Unna's boots and sclerotherapy. Two patients had high ligations done. There was a striking relief of pain after the second, third and fifth application. All three ulcers were cured after the ninth and twelfth bandage.

The second series consisted of four cases of chronic eczema of the lower leg, with partly deep and partly superficial ulcerations. One patient showed a moderate degree of varicose veins. The other three patients did not exhibit visible signs of venous disorder. These three patients were extremely obese, weighing between 250 and 310 pounds. There was a severe degree of lymphostasis in both legs. The eczematous areas were in the lower half of the legs. The skin appeared thickened, brown-red, partly covered with scales, partly deprived of epithelium, showing superficial and deep ulcerations with fetid secretions.

In all four cases the application of the b-k-p paste was restricted to the ulcera-

tions only. Since the paste had an irritating effect upon the eczematous skin leading to exudation, it had to be omitted occasionally. The patient with varicosities received sclerotherapy and three b-k-p paste applications with Unna's boots. Six more treatments with supportive bandages cured the eczema. The other three cases did not undergo surgical treatments. All ulcerations were cured with the b-k-p paste, using eight, nine and sixteen applications. Two patients of this group are still under treatment for chronic leg eczema without having blood paste applications.

In the third series there were four cases of varicose ulcers associated with arteriosclerosis of the vessels of the leg, one patient being sixty-seven years, the other sixty-eight, the third seventy-two, and the fourth sixty-five years old. One leg ulcer of a diabetic female (seventy-two years old) healed after eight applications of blood paste. One patient received eleven applications, then interrupted the treatment. After his return the small ulcerative area was undercut, and it closed up after sixteen applications of blood paste plus Unna's boots. The third patient showed a year-old ulceration of the size of a silver dollar in the middle of the lower third of the tibia. The surrounding skin presented a chronic eczema with signs of trophic disturbances. The wound had a torpid appearance without granulations. There was a large amount of fetid secretion. The patient received nine applications of blood-kaolin paste plus ceepryn (later on penicillin) plus Unna's boots. The ulcers closed entirely with a firm scar. In the fourth case the *treatment* with b-k-p paste had to be discontinued on account of pain and lack of coöperation. This patient showed two large torpid ulcers at the lower third of the lower leg surrounded by chronic phlebitic veins. She had suffered from varicose ulcers for twenty years and had been treated by pinchgrafts fifteen years ago.

The fourth group consisted of five cases of typical varicose ulcers ranging from the

size of half a fingernail up to a childs palm. All cases were treated uniformly with b-k-p paste and Unna's boots. They had persisted from three weeks up to eight months before treatment was instituted. In one case a three months old ulcer was cured after the first application of blood paste plus Unna's boot. In the other cases it took from six to twenty-two applications to effect a cure. Three patients of this group underwent high ligation and sclerotherapy, and two patients sclerotherapy alone.

In the fifth group was a patient who showed a torpid ulcer at the dorsum pedis. The patient, a bedridden seventy-four year old female, was suffering from excessive hypertrophic arthritis of both hands and feet, and from an intestinal malignancy. All joints were totally ankylotic; the skin of both feet and legs showed trophic disturbances. The ulcer of the foot was 1.5 inches by 2 inches in size. The area was extremely painful. The base did not show any granulations and had a dark red appearance. There was a low grade chronic infection. The patient received daily applications of blood-kaolin paste. Being at home she could not be closely supervised. After four weeks of more or less thorough treatment there was a slight improvement of the ulcer, but it never closed. A new ulcer formed on the other leg. The case could not be followed up. Therefore, the definite value of the blood paste could not be stated here. The patient finally succumbed to her malignancy.

In the last group were two cases of slough following sclerotherapy. The ulcerations which were of the size of a small pea and of a small hazelnut, respectively, closed up after eleven and fourteen semi-weekly applications of blood paste.

In a few cases the blood paste was used as a vehicle to which riboflavin, viosterol, sulfonamides and tincture digitalis (K. Schlaepfer and Baron) were added. A striking effect could not be noted. The series, however, was too small to allow any definite conclusion.

SUMMARY

A blood-kaolin-penicillin-paste was used in the treatment of 19 cases of varicose and trophic leg ulcers with and without chronic eczema. In two cases the paste failed to effect a cure. A thorough and exhaustive treatment, however, could not be carried out here.

Superficial and deep ulcerations were benefited by the blood paste, whereas chronic varicose eczema became aggravated.

Stimulation of granulations, promotion of epithelization, reduction of infection and a pain-relieving effect upon irritable ulcers were evident.

The paste can be easily made, using the patient's own blood, adding kaolin ana partes and ½ cc. of penicillin (5,000 units per cc.) to 10 cc. paste.

The b-k-p paste may be considered as a valuable adjunct in the treatment of varicose ulcers. It seems to exert a nutritional and protective effect upon the ulcerations. In the therapy, however, the reduction of the venous backflow by ligation, sclerotherapy and supportive bandages must not be neglected.

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BILATERAL FRACTURE OF THE SCAPULA

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THE paucity of reports in the literature relative to bilateral fractures of the scapula bespeaks their rarity. A careful review of the literature from 1916 to 1944 revealed no reference to a case of this type. It is possible that reports of such injuries may have been made and were missed by the authors, but it is believed that the injury is rare enough to warrant reporting the authentic case herein described.

Unilateral fractures of the scapula are still considered uncommon even with the almost universal use of x-ray in the diagnosis of fractures. The position, shape and size of this bone would lead one to believe it might be a frequent site of fracture. However, compared to the adjacent bones with which it articulates, it is relatively free from injury. This could well be ascribed to the thickened edges which reinforce the plate of bone, its great mobility on the chest wall and its position between thick pads of muscle.

MECHANISM

There are in general two mechanisms by which fractures of the scapula are sustained: indirect and direct violence. The former is the most common and is virtually the only means of fracture of the glenoid and surgical neck being produced if the fracture is not compounded. A fall on the hand, elbow or shoulder, with force transmitted through the humerus while the scapula is pulled forward by the serratus magnus, is the usual means of a fracture of this part of the bone, and there may be a buckling with a fracture of the body, spine or both. However, the latter component of the bone may be broken as the result of direct violence with varying degrees of damage to the soft parts. Fractures of the coracoid and acromion are relatively uncommon except in severe compound fractures about the shoulder. The foregoing facts should be taken into consideration in the selection of the choice of treatment in complicated fractures of the scapula.

CASE REPORT

A thirty-year old negro male, entered the hospital on July 6, 1944, with a chief complaint of pain in both shoulders. He stated that about one hour previously, while driving a heavily loaded truck on a loose-gravel road, the vehicle had overturned. The patient was never rendered unconscious although he was unable to state the exact manner in which he sustained his injury. He did state that he fell on his back with his shoulder striking the ground first, and the vehicle, under which he was pinned, struck him across the chest. It was concluded that this probable direct violence transmitted into his shoulder was the mechanism of injury in this case.

Physical examination revealed a short, strong-statured individual weighing 165 pounds with all findings essentially negative except for marked tenderness of both scapular regions and with limitation of movement of the shoulder joints. Any attempt to move his arms greatly aggravated his discomfort. X-rays revealed comminuted fractures of both scapulae. His

left scapula showed little displacement (Fig. 1), but his right had marked displacement of the fragments with considerable comminution.

placed about 3 cm. laterally and inferiorly with $\frac{1}{2}$ cm. separation of the fragments. There is an additional complete fracture through the sur-

FIG. 1. Simple fracture of the left scapula without displacement.

FIG. 2. Severely displaced and comminuted fracture of the right scapula. X-ray on the day of injury.

FIG. 3. Fracture of the right scapula two weeks after instituting skeletal traction with wires through the lower fragment. The wires may be seen in the x-ray.

FIG. 4. Right scapula ten weeks after injury showing good union in a moderately improved position.

(Fig. 2.) The roentgenologist described it as follows:

"There is a complete transverse fracture through the middle of the body of the right scapula which is markedly comminuted at its lateral extremity. The inferior fragment is dis-

gical neck with some comminution, but the distal part of the neck and the glenoid fossa are intact, with no disturbance in the relation of the shoulder joint."

The left scapula was treated by simple immobilization using adhesive tape with a wide

piece running around the chest from front to back just below the axilla and a cross strapping in back over the center of the scapula. The

FIG. 5. Photograph showing range of abduction ten weeks after injury.

right scapula was treated for several days with lateral skin traction followed by adhesive immobilization of the upper arm which resulted in no improvement. The patient was taken to the operating room on July 14, 1944, and the following procedure was carried out:

"A two inch diagonally placed incision was made over the vertebral part of the scapula at about the junction of its middle and lower thirds. The border was exposed and two stainless steel traction wires of .025 inch diameter securely applied through holes in the inferior fragment with about $\frac{1}{2}$ inch bite and about two inches apart. The lower wire was about one and one-half inches from the inferior border of the scapula. These wires were brought out through holes in the skin about one inch from the vertebral column running transversely across the back. Sulfanilamide was placed in the wound and it was closed with interrupted sutures of No. 0000 silk."

The patient was returned to the ward and medial traction on the lower fragment instituted, with the lateral traction apparatus set

up on the left side of the patient's bed. Ten pounds of weight were used on each of the two wires. In addition the involved arm was put up with ten pounds of adhesive traction made directly lateralward. This was done to make countertraction and to pull the glenoid laterally on the displaced lower fragment. Serial films during the period of skeletal traction indicated a 60 to 75 per cent correction of the displacement and a greater proximity of the fragments. (Fig. 3.)

After five weeks it was believed that maximum improvement had been obtained and the wires were removed on August 26, 1944. Physical therapy was started consisting of short wave diathermy, massage, active and passive motion and circumduction exercises. Function of the shoulder joint approximated 100 per cent by September, 1944, ten weeks after initial injury. (Figs. 4 and 5.)

COMMENT

An analysis of this case in retrospect reveals several observations of interest. There is apparently a very rare incidence of bilateral fracture of the scapula. Remarkably efficient function of the shoulder joint may usually be expected after union in cases with grossly displaced fragments if the fracture line does not involve the glenoid fossa or surgical neck. A great deal of difficulty in correcting the position of the displaced fragments is encountered in this area because of the thick padding of muscle, but at least some correction can be accomplished if direct continuous skeletal traction is made on the displaced fragment itself.

SUMMARY

1. A case of bilateral fracture of the scapula is presented which is the first to be reported in the literature, as far as the authors have been able to ascertain.

2. One of the fractures was badly comminuted and displaced. It was partially reduced by means of traction wires and the position greatly improved.

3. The mechanisms of injury and aspects of treatment are discussed.

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Rapid shallow breathing can be caused by pain of fractured ribs. The condition is dangerous because it leads to anoxia and carbon dioxide retention. The treatment is to relieve the pain either by morphia, by strapping the affected area, or by injecting local anaesthetic into the intercostal nerves in the vicinity of the fractures.

From "Surgery of Modern Warfare" edited by Hamilton Bailey (The Williams and Wilkins Company).

PERFORATED PEPTIC ULCER

A SERIES OF TWENTY-EIGHT CASES

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THE importance of peptic ulcer in the military service in time of war cannot be overemphasized. The adaptability of soldiers who require special dietary management and who are prone to frequent gastrointestinal symptoms is questionable, and the belief exists in many Army medical units that such men are a potential hazard to themselves and the organization. Frequently, soldiers are admitted to the hospital with some serious complication, and not infrequently this may appear as the first sign of the disease. It is the complication of perforation which will be discussed in this report, inasmuch as the condition always commands interest, both in the civilian as well as the Army hospital.

Many comprehensive reports and reviews of perforated ulcers can be found in the literature. Some of the largest series are reported by Thompson (500 cases), Odom and DeBakey (211 cases), Ross and LeTourneau (228 cases), Sangster, Fallis, Read and others. Herbert Willy Meyer reviewed 151 cases of his own in 1940, and in the same year J. Cosbie Ross reviewed 175 cases of the Royal Infirmary of Liverpool. It is not the intention of this report to review the literature, although much can be gained by a study of these large series. Certain factors have maintained a relatively high mortality for the condition which has not been altered appreciably by the advent of the sulfonamides or other recent advances.

At an Army Station Hospital, between January 1, 1941, and November 30, 1943, twenty-eight patients with perforated peptic ulcer were admitted. It is noteworthy that fifteen of these patients were admitted in the eleven months of 1943 under consideration. The relative increase in perforated ulcers can easily be explained on the relative strength reports at time of peace and war with the increased rate of induction of troops within this command. Moreover, the age incidence of those in military life is somewhat lower during mobilization than in peace time. It is generally agreed that peptic ulcer is a disease of young males. Jennings has

TABLE 1
AGE, RACE AND SEX INCIDENCE OF PERFORATED ULCERS

Age	No. Cases		
20 and under...	3	Male.........	27
21 to 25........	8	Female.	1
26 to 30........	9	White.........	22
31 to 35........	3	Colored.......	6
36 to 39........	3	Youngest.....	19 years
		Oldest........	39 years

corroborated this fact in his conclusion that before 1900, three out of six patients with perforation were women under twenty-five, one was an elderly female, one an elderly male, and only one a young male. Since 1920, nine out of ten have been young or middle-aged males. At this hospital most of the patients were between twenty-one and thirty years of age. (Table 1.) The youngest of the group under consideration was nineteen and the oldest thirty-nine. There was but one female, age twenty-five, in the series. Twenty-two of the patients were white and six were colored. Peptic ulcer is not unusual in the colored race and previous reports in the literature would tend to confirm its frequency as equal to that of the white race. During this period there were 92,094

admissions to the hospital and 629 patients were admitted with a diagnosis of peptic ulcer. The percentage of perforations in ulcer patients from this analysis alone is 4.4 without making any statistical corrections. (Table II.) The percentage of

TABLE II

INCIDENCE OF PERFORATION IN ULCERS

	1941		1942		1943		Total No.	Total Perf.	Perf. Per Cent
	No.	Perf.	No.	Perf.	No.	Perf.			
Duodenum.	120	3	171	5	296	11	587	19	3.2
Stomach	5	1	14	4	23	4	42	9	21.4
							629	28	4.4

No. of Admissions 1941–1943............ 92,094
Percentage of ulcers.................... 0.68
Percentage of perforations............. 0.03

ulcers is 0.68 which compares with other reports in the literature. It is interesting to note that 373 or 59.3 per cent of these patients were discharged from military service by reason of their disability. (Table III.) In contrast, twenty-one of the twenty-six (80.8 per cent) surviving military cases with perforating ulcers were discharged from the Army.

TABLE III

PERCENTAGE OF MILITARY DISCHARGES FOR ULCER

Year	Stomach		Duodenum		All Ulcers		Per Cent
	No. Cases	Disch.	No. Cases	Disch.	No. Cases	Disch.	
1941	5	1	120	85	125	86	68.8
1942	14	5	171	57	185	62	33.5
1943	23	13	296	212	319	225	70.5
Total	42	19	587	354	629	373	59.3

Most patients were admitted with symptoms of an acute condition of the abdomen. The classical history was one of generalized abdominal pain and vomiting. Pain in these patients was usually sufficiently severe to demand morphine and was frequently referred to the right or occasionally the left shoulder. In three patients the pain was predominant in the right lower quadrant, and it was eventually found that these patients had spillage of intestinal contents into the right abdominal gutter. There was nearly always some degree of rigidity up to the classical board-like abdomen unless the process had been well walled off for some period of time. The skin was usually moist and cold, the pulse moderately rapid. The blood pressure was low and the facies that of an impending catastrophe. Tenderness could nearly always be elicited in the mid or right epigastrium and occasionally in the right lower quadrant. Only eleven of the patients gave a previous history of ulcer symptoms of a year or more, and thirteen of these patients gave no previous history of indigestion prior to the present episode. Some of the histories dated for eight or nine years prior to admission, but no patient in this series had had a previous history of perforation.

The diagnosis of perforated ulcer may be supported by certain laboratory findings. Although all our figures are not available, many of the patients were subjected to upright roentgenograms of the abdomen for the presence of free air under the diaphragms, and several are recalled which showed no evidence of this finding. When present, subdiaphragmatic air is diagnostic. Of twenty-two cases in which hematologic studies were available, eighteen showed elevated white cell counts varying from 12,000 to 19,650, and polymorphonuclear counts varying from 44 to 94 per cent. (Table IV.) The other four patients presented normal blood counts on admission, even though the clinical examination revealed positive evidence of perforation for several hours. These counts varied from 4,000 to 9,050, with polymorphonuclear percentages from 74 to 82, and all except one rose to a pathological height within a few hours. The remaining patient was subjected to operation before a check-up count could be made. In view of the past and present experiences, therefore, we do

not believe that hematologic studies should be given much weight in making an early diagnosis of perforation.

TABLE IV
BLOOD COUNTS IN PERFORATED ULCERS

	Count Variation	Poly-morpho-nuclear Variation, Per Cent
With elevated count No cases 18	12,000 to 19,650	44 to 94
With initial normal count		
Case 1	4,000 (1st count)	74
	17,250 (2nd count)	80
Case 2	5,500 (1st count)	79
	9,950 (2nd count)	79
	13,850 (3rd count)	81
Case 3	9,050 (1st count)	82
	13,300 (2nd count)	92
Case 4	8,000 (1st count)	64

Peritoneal aspiration as reported by Steinberg and others has not been performed in any of this series. The diagnosis in all cases was believed sufficiently manifest by the examining surgeon from the clinical data at hand to warrant exploration. In three cases previously mentioned, the diagnosis was suspected to be appendicitis and McBurney incisions were performed. Upon finding a normal appendix and free intestinal contents in the peritoneum, two of these cases were further explored by high right rectus incisions. The remaining patient was operated upon through a transverse extension of the original McBurney incision.

The average time of onset of symptoms to time of operation was 14.3 hours. In Table v will be noted that most of the patients were seen between two and one-half and twelve hours and that most of those with history of perforation over twenty-four hours developed some degree of peritonitis. Of particular interest is a group of cases in which the perforation became temporarily sealed and in which the signs of perforation were not conspicuous. This has been referred by some

writers as subacute perforation. This series presented three such cases, and the belief exists that it probably occurs more commonly than statistics would indicate. The size of the perforation is usually small enough that it may be easily sealed by

TABLE V
RELATION OF PERITONITIS TO OPERATIVE DELAY

Delay in hours	2½ to 12	13 to 24	24 to 72
No. cases	22	2	4*
No. peritonitis	3	1	3*
Average		14.3 hours	

* 1 death.

either a fibrinoplastic exudate or by cohesion to an adjoining viscus as liver, other portion of the gut, or even abdominal wall. The degree of spillage of gastric or duodenal content would seem to control the degree of peritoneal irritation present, and such cases may even show signs predominantly localized to the right lower quadrant or right colonic gutter. Such was the case in three of these patients in this group. The process around the ulcer may be sufficiently walled off to prevent a leucocytic response from showing in the blood counts. Other signs as fever, peristaltic movements, and rigidity may be also misleading. Continued tenderness whether localized to the right gutter or epigastric region eventually leads to exploration. Peritoneal aspiration would undoubtedly add much to the diagnosis of this type of case. One patient was so classical of this particular type of pathology that his case is presented in detail:

CASE REPORTS

CASE 1. (Subacute perforation): G. B., a colored male, age twenty-seven, was admitted 1:30 A.M., November 14, 1943, with severe generalized abdominal pain of four and one-half hours' duration. He stated that his stomach had been hurting him some all week and had received some medicine just twelve hours previously from a doctor at the dispensary. Severe pain did not occur until 9 P.M. It was cramp-like and doubled him up. He vomited twice

soon after its onset. He felt as though his bowels were going to move but experienced no action. After admission he was observed by the medical service and his pain subsided soon thereafter. The past history indicated that he had stomach trouble off and on for about nine years. Sometimes he would experience no discomfort for nearly a year, then would have a spell that lasted a month or two. This abdominal distress was sometimes brought on by eating cold heavy food. He stated that he was told that he had an ulcer in June, 1943, when he consulted a doctor, who restricted his diet to raw eggs and milk, and forbade him from eating meat and drinking whiskey. He never had to stop work because of his disorder, and had never experienced an attack as severe as the present episode. Other than stomach complaint he had never had any sickness except colds. He did have gonorrhea in 1937 and took 70 "shots" for syphilis, the last one being in August, 1943. The doctor who treated this told him his blood and spinal fluid were negative and pronounced him cured.

Due to persistent tenderness in the epigastrium, a surgical consultation was requested and he was transferred to the surgical ward at 1 P.M. on the day of admission. Examination revealed a young colored male, who was mildly tender over the whole abdomen with accentuation in the right lower quadrant and epigastric regions. He was evidently quite comfortable and showed none of the anxiety characteristic of intestinal perforation. Peristalsis was present and apparently normal in quality. Temperature by mouth was 98.8°F. Hematologic studies revealed an initial white cell count of 11,000 with 86 per cent polymorphonuclears. Due to the uncertainty of the diagnosis between possible appendicitis and subacute perforated ulcer, decision was made to observe him further. A Wangensteen tube was inserted into the duodenum, intravenous fluids were started and he remained relatively comfortable. Upright flatplate of the abdomen was unsatisfactory as it did not include the diaphragm level. A second and third white cell count at three-hour intervals revealed subsequent leucocytosis of 10,500 and 16,200 with 80 and 86 per cent polymorphonuclears, respectively. Another upright flatplate of the abdomen revealed a small amount of air under both diaphragms. The abdominal findings were unchanged, the tenderness being only moderately severe in the epigastrium, and with no evidence of rigidity. Peristalsis was still normal.

Twenty-six hours after his first severe symptoms he was taken to the operating room (11 P.M.), and under spinal procaine anesthesia, a high right rectus incision made. Only a small amount of turbid fibrinous peritoneal fluid was present. There was a fibrinoplastic exudate firmly sealing in 4 mm. perforation of the anterior surface of the first portion of the duodenum which was easily closed with interrupted chromic sutures. After implanting 8 Gm. of sulfanilamide into the peritoneal cavity, closure with cotton was effected without drainage. His postoperative course was uncomplicated and he was transferred to the medical service on his twelfth postoperative day for continuation of medical dietary management.

The impending nature of perforation in peptic ulcer does not permit much delay for preoperative preparation. Patients were given, however, intravenous fluids as soon as the diagnosis was suspected, to overcome the loss of fluid and electrolytes through repeated vomiting. None of the patients in this report suffered hemorrhage with perforation and blood transfusion or plasma administration was seldom deemed essential. The anesthetic of choice was spinal procaine inasmuch as most personnel were sufficiently acquainted with its use and it afforded adequate relaxation for the period of time usually required for this type of laparotomy. DeBakey has reported moreover, that the mortality in perforated ulcer laparotomies is generally lower with spinal than with other forms of anesthesia.

The ulcer at the time of operation was found to be in the stomach in nine cases and in the duodenum in nineteen. The duodenal lesions were all in the first portion of that organ on its anterior surface. In the stomach cases seven were anterior and prepyloric, one was on the lesser curvature and one on the greater curvature. The average size of perforation was described as varying from 2 to 6 mm., but one case presented a 5 cm. perforation. The size of the perforation, it is believed,

is not of particular importance but in the latter case, death resulted from widespread peritonitis.

CASE II. (Perforation with fatal peritonitis): H. C. B., a thirty-five year old white male, entered the hospital June 13, 1943, with epigastric pain. He had a past history of indigestion for six to seven years for which he had taken soda. The pain for which he had become hospitalized began twenty-four hours prior to admission and was fairly severe. It was not relieved by either soda or food and he had vomited several times. He was observed by the medical service and given a soapy enema in an effort to correct a mild distention. The abdomen to the examiner was not rigid but was extremely tender in the epigastrium. No note was made of peristalsis. Hematology studies revealed 5,500 white blood cells and 79 per cent polymorphonuclears. His progress during the next twelve hours was steadily worse. Tenderness increased and rigidity became apparent. By the eighteenth hour, he was in shock with cold clammy skin, pulse of 126, blood pressure 70/40 and classical Hippocratic facies, and a surgical consultation was requested. It was apparent that he then had a perforated peptic ulcer. Check-up hematology revealed 13,850 white blood cells with 81 per cent polymorphonuclears and an upright roentgenogram showed free air under both diaphragms.

With the administration of 1,000 cc. of whole blood by transfusion, a high right rectus incision was made under local anesthesia. Between 4,000 and 5,000 cc. of bile-stained fluid were removed from the peritoneal cavity. This fluid contained particles of gastric content. A 5 cm. perforation was found on the greater curvature of the stomach surrounded by a plastic exudate. Closure by interrupted silk sutures was quickly effected, 10 Gm. of sulfanilamide implanted intraperitoneally, and Penrose drains placed in the peritoneal cavity before layer closure of the wound.

His postoperative convalescence was steadily downward despite transfusion and other intravenous fluids. Oxygen therapy was given by B.L.B. mask and 4 cc. eschatin given intramuscularly. He expired thirteen hours following the operation. Autopsy revealed scattered areas of atelectasis in both lungs with early bronchopneumonia, but the evident cause of death was widespread peritonitis.

The ulcer in 7 patients was still emptying intestinal contents at the time of exposure but the usual finding was a natural but inadequate attempt at closure of the opening by a plastic exudate. All patients had varying amounts of free peritoneal fluid and in some, the fluid showed evidence of turbidity.

The operation in all cases was simple closure of the ulcer and only three patients were subjected to rubber tissue drainage of the peritoneal cavity. The closure was usually effected by interrupted fine chromic catgut, silk, or cotton, or occasionally a purse-string suture if the borders of the ulcer were not too friable or edematous. The ulcer was frequently so indurated that it was difficult to insert sutures that would not tear the serosa unless large bites were taken. The simplest method in this type of ulcer was to bend the ulcer on itself and suture adjacent walls of the organ together over it. Usually a tag of omentum or a free omental graft was placed over the site of closure. Twenty-two of the patients had sulfanilamide implanted in the peritoneal cavity in amounts varying from 4 to 12 Gm. This was always supplemented by oral or intravenous administration of some form of sulfonamide after the first twenty-four hours postoperatively. The peritoneal administration of the drug was believed to give an adequate initial concentration during the time that the patient was unable to tolerate oral administration.

Postoperative care consisted in prompt institution of continuous gastroduodenal drainage by the method of Wangensteen. By the use of this tube, patients were able to take small amounts of water after forty-eight hours, the excess flowing through the tube. The tube was usually removed permanently in three to four days when the patient was able to expel flatus voluntarily. Fluid requirements were met religiously, the usual minimal amount being 4,000 cc. daily, half of which was normal saline solution. As the oral intake increased, the intravenous requirements diminished

so that patients were usually able to sustain themselves by the fourth postoperative day. On the latter date Sippy management was usually instituted and continued faithfully until the patient was transferred to the medical service. Patients with uncomplicated convalescence were transferred to medical convalescent wards by the ninth to the twelfth postoperative day.

In patients with peritonitis in whom prolonged administration of parenteral fluid was required or in whom food balance was lacking, vitamins and proteins were instituted as recommended by Holman. Cevitamic or ascorbic acid, 100 mg. daily, was the basis for the required vitamin c intake. There was one case of wound disruption in which the drug was not used and this may or may not have influenced this complication. Protein requirement was supplemented by parenteral plasma injections of 250 cc. daily or 500 cc. on alternate days. No patient in this series of cases was sufficiently anemic or hypoproteinemic from perforation alone to justify transfusion of whole blood, but our fatal case received blood for severe shock.

TABLE VI
COMPLICATIONS OF PERFORATED ULCERS

	No.	Per Cent	Died
Peritonitis (clinical)	7	27.7	1
Phlebothrombosis (femoral)	1	3 9	0
Wound disruption	1	3 9	0
Pneumonia (postatelectatic)	3	11.5	0
Empyema (postpneumonic)	1	3 9	0

One cannot overemphasize the necessity of frequent change of position postoperatively in perforated ulcer patients. The incidence of atelectasis and pneumonia in this series (Table VI), as in others, rises easily in a patient with a high rectus incision who is unwilling to cough. Prompt attention is recommended to all who develop atelectasis with particular emphasis on deep breathing, voluntary cough, and even tracheal suction or bron-

choscopy if indicated. Morphine is given in sufficient amounts to allay pain but not sufficiently to reduce the respiratory rate appreciably or to produce constant somnolence. The following case is given in some detail inasmuch as it portrays certain complications which are commonly seen:

CASE III. (Perforation with postoperative empyema): Mrs. B. P., a white female age twenty-six, entered the hospital January 8, 1943, with pain in the lower right anterior thorax which had been present some twelve hours prior to admission. She stated that she had not felt well for the past three weeks and had a chest cold which persisted. There was no true gastrointestinal past history. Examination revealed a patient who appeared ill with slight cyanosis, temperature of 102.4°F., and with grunting respirations. Examination of the chest revealed râles and diminished breath sounds over the right base. There was a definite pleural friction rub over the anterolateral aspect of the fifth right interspace. Rigidity of the upper abdomen was present and the patient exhibited moderate tenderness in the entire epigastrium. She vomited soon after admission and a Wangensteen tube was inserted for apparent distention. A flatplate roentgenogram of the abdomen in the upright position was negative for subdiaphragmatic air and the film confirmed the finding of atypical pneumonia in the right lower lobe. She was placed in an oxygen tent and given sulfonamides and intravenous fluids.

After ten hours, due to the persistence of abdominal rigidity and tenderness, she was taken to the operating room where a high right rectus incision was made under spinal pontocaine anesthesia. The peritoneal cavity was filled with 1,200 cc. of turbid fluid, and showed evidence of a plastic exudate over the anterior duodenum lightly sealing a small perforation. Closure was easily effected by interrupted silk sutures, 8 Gm. of sulfanilamide implanted intraperitoneally, and returned to the ward in fair condition. The patient continued to run a fever to 102°F. after the third postoperative day and check-up roentgenogram of the chest revealed an increase in involvement in the right lower lobe and a new process in the left lower lobe. A blood transfusion of 500 cc. was given to aid the patient's resistance. By the twelfth

postoperative day it was evident that all her pathological symptoms were limited to the chest as the incision was well healed and she had been taking a diet without any abdominal symptoms. On January 31st, due to the finding of dullness over the left lower thorax, and due to a subsequent finding of pus on aspiration, a thoracostomy was performed under local anesthesia, resecting a portion of the eighth left rib posterolaterally. About 800 cc. of pus were recovered and the drainage tube was placed into an under-water trap. By February 5th, there was evidence of dullness over the right base as well as a persistence of fever to 101°F. Aspiration revealed turbid fluid and 250 cc. were removed. Three subsequent aspirations were successful in obliterating the right-sided effusion and she became afebrile. Her thoracostomy wound and pleural sinus closed and she was discharged from the hospital February 21, 1943. She was seen again December 6th when she was complaining of moderate epigastric distress following meals over the past two months. Check-up roentgen studies of the stomach and duodenum showed pyloric obstruction. On January 13, 1944, a subtotal gastric resection was performed. The specimen revealed a chronic duodenal ulcer, adherent to the abdominal wall, with considerable surrounding edema. Postoperative convalescence was uneventful except for a transient hemolytic jaundice resulting from a transfusion reaction. She was discharged, asymptomatic on her twenty-first postoperative day.

CONCLUSIONS

1. A series of twenty-eight perforated peptic ulcer cases is reviewed in which there was but one death or a mortality of 3.57 per cent.

2. Although the series is small, the incidence of perforated ulcers in this military hospital is 0.03 per cent of all hospital admissions. The incidence of all peptic ulcers in this hospital corresponds to civilian figures, and is 0.68 per cent of all hospital admissions.

3. Of all peptic ulcers admitted to this Station Hospital during 1941 to 1943, 59.3 per cent were discharged from military service, while the percentage of perforated ulcers discharged from the service was 80.8 per cent.

4. A small but definite group of cases of subacute perforation is emphasized inasmuch as it is believed that the condition exists more often than figures would tend to indicate. One classical example of this type of case is presented in detail.

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CIRCUMSCRIBED POST-TRAUMATIC OSTEOPOROSIS OF THE LOWER ENDS OF THE RADIUS AND ULNA

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D. La M., a forty-five-year old white Brazilian male, was seen by the writer for the first time on October 18, 1944, because of a disability resulting from an injury to his left wrist. He stated that one year previously (October 15, 1943), a part of a gyro weighing about fifteen to twenty pounds fell a distance of several inches and struck the palmar surface of his left wrist pinning it against the top of his work bench. He experienced immediate pain and thereupon stopped working. Four days later he was seen by a physician who found that the left wrist joint was deformed in that there was anterior bowing of the lower end of the ulna accompanied by widening of the wrist. The acute condition was diagnosed as a contusion and sprain of the wrist joint.

Notwithstanding that physiotherapy was administered, the patient's condition grew worse. He therefore placed himself on October 29, 1943, under the care of a second physician complaining of a painful swollen lower portion of the forearm, numb fingers and weakness of the grasping power. Examination at that time revealed swelling and tenderness over the volar aspect of the distal portion of the forearm, subluxation of the head of the ulna anteriorly, limitation of all motions of the wrist, tenderness over the carpal canal, weakness of flexion of the fingers, and numbness of all fingers. More physiotherapy was administered without any evident improvement.

The patient was therefore seen by a neurologist on November 26, 1943. The latter found a swelling on the ulnar nerve above the wrist. He further noted that the left hand was colder and clammier than its mate. His impression was that the patient was suffering from a traumatic neuritis of the ulnar and median nerves. About three weeks later the patient was found to have less swelling over the lower end of the ulna, marked tenderness over this area, pain and limitation of all motions of the wrist, limitation and weakness of flexion of all fingers, hypesthesia of the second, third, fourth and fifth fingers in ulnar and median nerve distribution and slight swelling of the palm.

Continued therapy gave no relief. A fourth physician was consulted on May 9, 1944. The latter found complaints of weakness, defects, and pain on all motions of the hand and wrist and numbness of the third, fourth and fifth fingers. His examination revealed a large and irregular head of the ulna, pain on supination and pain and limitation of pronation of the forearm, pain and limitation of all motions of the wrist, and weakness of motion of the fingers apparently due to apprehension. There was no atrophy of the intrinsic muscles of the hand and the circulation was good. There was hypesthesia of the volar aspect of the ulnar side of the wrist and the palmar aspects of the third fourth and to a lesser extent the fifth finger. This consultant believed that the patient was suffering from a long standing mechanical disturbance of the radio-ulnar joint and a disappearing disturbance in the sensory distribution of the ulnar nerve and a small part of the median nerve. He therefore advised a subperiosteal resection of the head of the ulna. This was performed on May 23, 1944. The resected specimen was unfortunately discarded without a microscopic study. Subsequent to his discharge from the hospital on June 23, 1944, no further treatment was administered.

When the patient came under the writer's observation on October 18, 1944, he complained of three or four recurrent attacks of swelling of the left hand lasting about twenty-four hours each accompanied by severe pain. He further complained of pain of the hand and forearm on all their aspects, weakness of the hand and a clicking sensation of the forearm on pronation and supination.

Examination revealed that the patient was apparently in good general condition though somewhat apprehensive. There was no evident involvement of the left shoulder or elbow. Supination of the forearm was slightly restricted and painful when forced. Pronation

was only possible to about half the normal range of motion and was accompanied by a click and sharp pain. The lower end of the ulna

process of the ulna was un-united. Its border was well demarcated and smoothed. The styloid process presented three smooth round areas of

FIG. 1. D. La M., circumscribed post-traumatic osteoporosis of lower end of ulna, radius, and carpal bones. Note: (1) Non-union of styloid process of ulna; (2) rounded areas of rarefaction in styloid process of ulna, distal ends of ulna radius and of os magnum and unciform; (3) mushroom-shaped deformity of distal end of ulna; (4) preponderance of sparse, coarse longitudinal bone lamallae over transverse lamallae in carpus and adjoining metaphyses.

had apparently been removed and there was localized tenderness over its distal end. Passive manipulation of the ulna in an anteroposterior direction produced pain. There was considerable perspiration of the left hand, more so than of the right. The skin of the palm and fingers was smooth and velvety. Aside from weakness there was no involvement of the intrinsic muscles of the hand. All motions of the wrist were unrestricted though somewhat painful at the extremes. All motions of the fingers were unrestricted and painless. The grasping power of the hand was diminished. There was hypesthesia to touch and scratch of the lower two-thirds of the forearm, wrist, hand and fingers. The left arm was atrophied ½ inch, the forearm, wrist and palm ¼ inch.

Examination of roentgenograms (Fig. 1) made on October 25, 1943, and October 28, 1943, ten and thirteen days after the above described injury revealed that the styloid

rarefaction. The distal end of the ulna also revealed several rounded areas of rarefaction and was deformed and somewhat mushroom-shaped. The distal end of the ulna presented at its radial surface a parrot-beak formation. The bony architecture revealed a preponderance of longitudinal lamellae with a diminution of the transverse lamellae. The distal portion of the radius revealed several small areas of rarefaction. The lower portion of the shaft as well as the metaphysis presented the preponderance of the coarse longitudinal striae noted in the ulna. The carpal bones especially the os magnum and the unciform presented small rounded areas of rarefaction. The bony lamellae were sparse, coarse and accentuated and were longitudinally arranged. This was also true of the proximal metaphyses of all of the metacarpal bones.

Roentgenograms made on May 25, 1944, revealed that the distal 1 to 1½ inches of the

ulna had been surgically removed. Two small fragments of bone remained at the site of the distal end of the ulna. One of these because of its size, shape and contour was apparently the un-united styloid process of the ulna. The bony architecture previously described was still apparent.

Roentgenograms made on August 31, 1944, and on November 16, 1944, reveal an essentially similar appearance.

Physiotherapy was instituted by the present author and great stress was placed upon the functional use of the hand on all possible occasions. In addition the patient was constantly reassured of an eventual satisfactory outcome. Recovery has been slow but progressive though not as yet complete.

The interest in this case centers about the nature of (1) the localized bone changes in the os magnum and unciform, and in the distal end of the ulna, the deformity of the head of the ulna, its ununited styloid process and the distal end of the radius; (2) the diffuse bone changes characterized by the sparsity and coarseness of bone lamellae and preponderance of longitudinal lamellae in the carpal bones and adjacent metaphyses; and (3) the clinical picture presented subsequent to the injury of October 18, 1944.

Repeated questioning of the patient has resulted in denials on his part of any preceding injury or symptom complex referrible to the left wrist. The roentgenographic findings are nevertheless indicative of a long standing disturbance of the bony architecture of the involved parts antedating the present injury. These seemingly contradictory facts are, however, not at variance with a circumscribed post-traumatic osteoporosis of the separated styloid process, the head of the ulna and the lower end of the radius and the os magnum and unciform, very much akin to the similar though more common process occurring in the carpal semilunar (Kienbock's disease) and the carpal scaphoid (Preiser's disease). The present author has had the occasion to describe this condition in the os magnum and the unciform.[1] Esau[2] and others have since made similar observations. King[3] was

the first to describe this condition in so far as it affects the distal end of the ulna. Both of his cases present an identical appearance to that described in the case under discussion. King's second case gave "no history of recent injury to the region, but there was definite evidence of the separation of the styloid process and some irregularity of the head of the ulna. The condition was discovered accidentally when the wrist was x-rayed on account of a recent injury to the radial side of the hand."

The second point of interest in this case is the sparsity and coarseness of bone lamellae and the preponderance of the longitudinal lamellae in the carpus and the adjacent metaphyses. This appearance is the characteristic end result of the diffuse post-traumatic osteoporosis frequently described as Sudeck's atrophy. The author has noted several such instances one of which he has had occasion to describe in detail.[4] The following case report clearly demonstrates the roentgenographic appearances in Sudeck's atrophy as well as the characteristic end result.

Charles F. P., a fifty-year old white male sustained, as a result of an automobile accident on April 15, 1936, a fracture of the lower end of the right radius without displacement of the fragments. An anterior molded plaster of Paris splint was applied and subsequently removed at the end of three weeks. It was noted at this time that he had great pain and stiffness in his hand and fingers. In addition he began to experience at this time pain and limitation of motion in the right shoulder. Physiotherapy was administered without any apparent relief.

The patient was seen by the author on August 26, 1936, when the skin of the right hand and fingers was found to be velvety, shiny and atrophic. There was inability to make a fist and the grasping power of the hand was considerably diminished. The thenar and hypothenar eminences were atrophied. All motions of the fingers and wrist were greatly restricted and painful at the limits of motion. The forearm, elbow and lower two-thirds of the arm were clinically uninvolved. There was pronounced atrophy about the shoulder joint. The anterior aspect of the joint area was tender.

FIG. 2. C. F. P., September 8, 1936, diffuse post-traumatic osteoporosis of wrist. Note. (1) Pronounced punctate areas of rarefaction in the carpus, adjacent metaphyses, and metacarpals; (2) early appearance of coarse longitudinal bone lamallae.
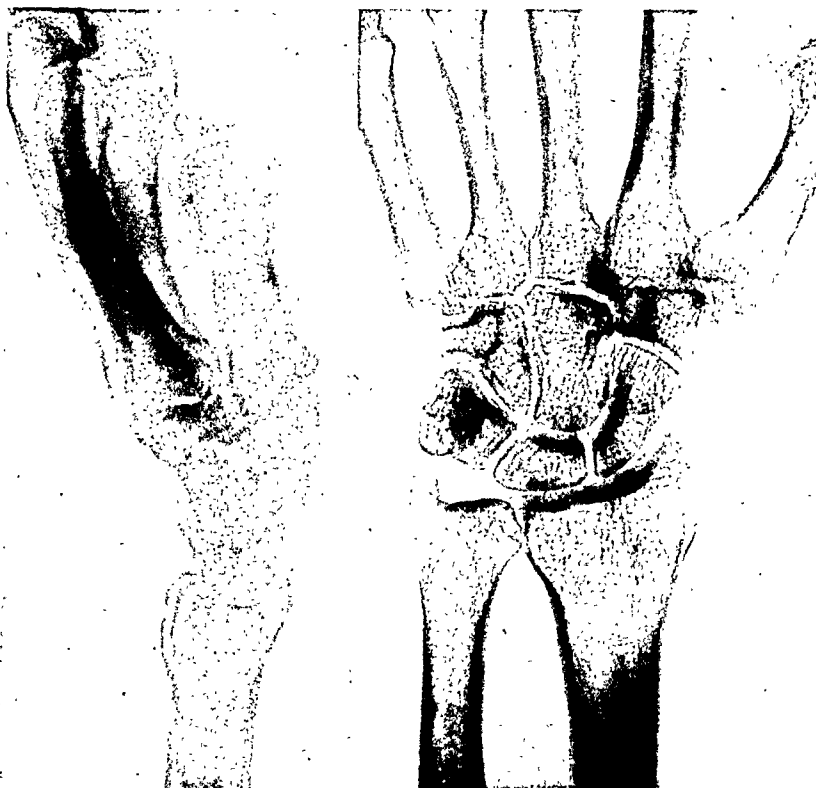

FIG. 3. C. F. P., October 9, 1938, end result of diffuse post-traumatic osteoporosis shown in Figure 2. Note preponderance of coarse sparse longitudinal bone lamallae over transverse lamallae.

All motions, active and passive, at the glenohumeral articulation were for all practical purposes absent and painful.

Examination of roentgenograms (Fig. 2) made on September 8, 1936, five months after the accident, revealed faint traces of a healed fracture of the lower end of the radius without any displacement of the fragments. The distal ends of the radius and ulna, all of the carpal bones, the metacarpals and the phalanges showed pronounced punctuate areas of rarefaction. In the carpal bones and to a lesser extent in the other parts coarse longitudinal trabeculae were already evident. Roentgenographic examination of the shoulder revealed punctate osteoporosis of the head and upper portion of the humerus, the distal end of the clavicle, and the acromion and the neck and glenoid portion of the scapula.

Physiotherapy in the form of baking, diathermy and massage was administered together with gradually increasing active function. After a period of four months of additional therapy the patient was completely relieved of his symptoms save for some residual stiffness of the fingers. His clinical course lasted about a total of nine months.

A roentgenographic examination of the right wrist (Fig. 3) made on October 29, 1938, thirty months subsequent to the accident revealed that the involved parts have been recalcified. The architecture of the bone was coarse and sparse with a predominence of the longitudinal as against the transverse lamellae.

The third point of interest in this case is that the recent clinical symptom complex is characteristic of Sudeck's atrophy with the exception that during the present disturbance no new osteoporosis has developed.

King,[3] in his monumental monograph on "Rarefying Conditions of Bone" which won for him the Jacksonian Prize of the Royal College of Surgeons, has emphasized the close relationship of the diffuse form of post-traumatic rarefaction of bone as exemplified by Sudeck's bone atrophy and Kummel's disease and other more uncommon forms and the circumscribed form of post-traumatic rarefaction of bone as exemplified by Kienboch's disease, Preiser's disease and the rarer forms such as the

instance under discussion. The present writer as well as other investigators have seen and described instances in which both forms have occurred in the same part either simultaneously or at intervals apart. The following case report is an excellent example of a long standing circumscribed osteoporosis upon which a diffuse osteoporosis has been superimposed at a later date.

Harry H., a twenty-five-year old white male, stated that while simonizing a car on November 20, 1940, his right hand slipped and his wrist struck against a bumper guard. He experienced immediate pain and swelling of the wrist but continued working with his left hand. On the following day he complained of severe pain in the right wrist. He was therefore referred to a physician and was discharged from his job. Physiotherapy was administered but the pain and disability persisted and was sufficiently severe to prevent him from working for two months. Thereafter he returned to light work which was performed chiefly with his left hand.

There was an additional history of an injury to the knuckle of the right index finger about eight or ten years previously. No treatment was ever administered for this condition.

When I saw the patient four months after the injury he complained of pain and weakness in the right wrist on working and pain at night.

Examination revealed a complete loss of dorsiflexion of the wrist. Palmar flexion was restricted to 150 degrees, and ulnar and radial deviation were only possible to a few degrees. The extremes of all motions of the wrist as well as pronation and supination of the forearm were painful. The tenderness which was present over the entire wrist was greatest over the semilunar and cuneiform bones. The prominence of the knuckle of the index finger was diminished. The grasping power of the hand was greatly lessened. The arm and forearm were somewhat atrophied.

Examination of a roentgenogram (Fig. 4) made seven days after the accident revealed a punctate osteoporosis involving the entire carpus, the distal ends of the radius and ulna and the proximal ends of the metacarpal bones. The semilunar was sclerotic, deformed and fragmented. The cuneiform was markedly

porotic. The head and neck of the second meta-carpal were deformed and displaced.

It therefore appeared to the author that the

FIG. 4. H. H., November 27, 1940, circumscribed post-traumatic osteoporosis of semilunar and diffuse post-traumatic osteoporosis of wrist. Note: (1) Fragmentation, deformation and sclerosis of semilunar bone; (2) diffuse punctate osteoporosis of carpus and adjacent metaphyses.

patient was suffering from a diffuse post-traumatic osteoporosis of the entire carpus and adjacent bone structures superimposed upon a previously existing circumscribed post-traumatic osteoporosis of the semilunar bone, otherwise known as Kienboch's disease.

Immobilization in a circular plaster of Paris bandage from the metacarpophalangeal joints to the elbow was advised and applied from time to time over a period of eighteen months from the date of the accident. Examination on May 1, 1942, revealed that all motions of the wrist were greatly restricted, the extremes of motion were painful, and the tenderness save that over the semilunar had disappeared.

Radiographic examination made on April 28, 1942, demonstrated that the diffuse punctate osteoporosis had disappeared. The lamellar structure of the previously involved areas showed a considerable diminution in the trans-

verse elements while the longitudinal elements were coarse and sparse. The deformity of the semilunar bone was increased and the joint

FIG. 5. H. H., November 20, 1942, end result of circumscribed and diffuse post-traumatic osteoporosis shown in Figure 4. Note: (1) Preponderance of coarse though sparse longitudinal lamallae and relative diminution of transverse lamallae; (2) increased deformity of semilunar bone and persistent fragmentation and sclerosis; (3) diminution of joint spaces; (4) disappearance of punctate osteoporosis.

spaces, especially the radiocarpal, were more diminished in size when compared to the original film.

Gradual mobilization of the wrist and physiotherapy were advised and instituted. A further roentgenographic study two years after the accident (Fig. 5) demonstrated the above described changes more clearly. Clinically, however, there were residual changes such as pronounced limitation of motion, pain on extremes of motion, tenderness and weakness which were indicative of arthritic changes. The prognosis was therefore poor even though the diffuse post-traumatic osteoporosis had subsided.

Both the circumscribed as well as the diffuse form of post-traumatic osteoporosis are thought to be due to a functional dis-

turbance of the vasomotor mechanism of the parts involved and are merely expressions of degree of involvement. In these forms the osteoporosis and the resulting after-effects such as loss of motion and deformity are the prominent symptoms. In other forms the osteoporosis may be minimal or non-existent as exemplified by the present case history under consideration. All of these forms are closely related and vary only in that one or another aspect may become predominant in the clinical picture even though all of these forms have many of the clinical features in common.

Because of this variance in one or another phase of the condition under consideration, the terminology has been varied even though they all refer to what is in all probability the same condition. The more common terms employed in the literature are Sudeck's bone atrophy, acute bone atrophy, post-traumatic osteoporosis, reflex dystrophy of the extremities, reflex nervous dystrophy, segmental angiospasm, and minor causalgia.

CONCLUSION

The purpose of this presentation is:

1. To demonstrate a very rare form of circumscribed post-traumatic osteoporosis of the lower end of the ulna and radius associated with similar changes in the os magnum and cuneiform akin to the better known localization in the semilunar bone (Kienbock's disease) and scaphoid (Preiser's disease).

2. To demonstrate the occurrence of the circumscribed form and the diffuse form of osteoporosis (Sudeck's atrophy) in the same patient as manifested by the characteristic bone changes incidental to the recovery from both conditions.

3. To demonstrate the relationship between the circumscribed and diffuse forms of post-traumatic osteoporosis on the one hand and the clinical syndrome (reflex dystrophy of the extremities) which is very much akin to the diffuse form of post-traumatic osteoporosis with the exception that the bone changes may be minimal or entirely absent on the other hand, thus demonstrating that these three forms of functional disturbance of the vasomotor mechanism of the parts involved are merely expressions of degree of involvement.

4. To demonstrate the occurrence of the three forms of vasomotor disturbance in the same part of the same patient at different times, probably indicating an inherent susceptibility of the individual under consideration.

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TUBERCULOSIS OF THE THIRD PORTION
OF THE DUODENUM

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ONE of the rarest conditions encountered in the abdomen is tuberculosis limited to a small segment of the duodenum. There are less than a dozen proven cases reported in the literature. The finding of this pathological condition is usually a pleasant surprise for invariably the preoperative diagnosis is malignancy and malignancy in this region means involvement of the pancreas, so that one ordinarily operates and expects either to undertake a formidable operative procedure, such as removal of the duodenum and head of the pancreas, or else he will perform a short circuiting operation such as a gastrojejunostomy. When the diagnosis of tuberculosis is made, a resection of the involved bowel with either an end-to-end or side-to-side anastomosis is all that is necessary and the prognosis is not as grave as it is in carcinoma. The following is such a case in which the patient was operated upon by me one year ago:

CASE REPORT

Mr. S. S. was admitted to the Rhode Island Hospital on March 3, 1943, with a diagnosis of carcinoma of the third portion of the duodenum. The history reveals that he had had "stomach trouble" for four months. At the onset there was intermittent colicky pain over the lower abdomen which later settled in the mid-epigastrium. The pain was not referred to the shoulder or back.

The pain usually followed meals. "Fat and fried food were no worse than others." More food or alkali would not relieve the symptoms but usually aggravated the condition. As time went on the heavy food would "stay on my stomach for a long time," reported the patient

and then vomiting would bring relief. During the last month only liquids such as "milk and soups would stay down." He had not noted any blood in vomitus or stools although· he admitted rarely looking for bloody or tarry stools. During the last three months he had lost eleven pounds.

The past history, family history and physical examination were entirely negative. A gastrointestinal series had been performed previous to admission and was repeated in the hospital. The reports follow:

December 28, 1942: "Examination of the gastrointestinal tract shows normal esophagus. Stomach was normal in position and had a smooth contour. Peristalsis was normal and there was no delay in the emptying time. The duodenal bulb was well outlined and showed no pathology. A short segment of the duodenum at the junction of the second and third portion was narrowed and irregular in outline. The mucosal pattern was obliterated in this area and there was a sharp delineation between the involved and normal intestine. There was considerable delay in the passage of barium in this region and the descending duodenum proximal to the point of narrowing was dilated and showed reverse peristalsis at the fluoroscopic examination. At the four-hour examination there was a small amount of residual barium in the second portion of the duodenum. Otherwise, there was normal motility in the small intestines and the barium had reached the transverse colon. At the twenty-four-hour examination the cecum and colon were not remarkable. Two examinations were made of the gallbladder by the oral method and showed a normal functioning gallbladder. There were no calculi.

"Conclusion: Examination reveals a narrow irregular sharply delineated defect at the proximal end of the third portion of the duodenum which is consistent with malignancy."

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March 5, 1943: "Examination of the gastro-intestinal tract showed the stomach in good position and of normal outline. Peristalsis was normal. There was no delay in the emptying time. There was marked narrowing of a small segment of the proximal end of the ascending or third portion of the duodenum. There was a sharp line of demarcation between the involved and normal intestine in this area. The second portion of the duodenum was dilated and there was reversed peristalsis present. The findings are due to an obstructive lesion in the proximal end of the third portion of the duodenum, as previously noted."

March 24, 1943: "Examination of the chest shows no infiltration in the upper lobes or other pathology in the lungs. The diaphragm shadows are of normal outline. The heart and great vessels are within normal limits."

The laboratory findings were as follows: Hinton test, negative; hemoglobin, 16; red blood count, 5,870,000; white blood count, 8,550; differential: polymorphonuclears, 67; eosinophils, 2; small leucocytes, 24; large leucocytes, 7; urea nitrogen, 18; glucose, 90; sodium chloride, 454; total protein, 7.6; gastric analysis, within normal limits.

Preoperative diagnosis: Obstructing lesion of the third portion of the duodenum, probably carcinoma.

Operation was performed on March 10, 1943, under fractional spinal anesthesia. An upper right rectus muscle-splitting incision was made. Exploration of the stomach and of the first and second portion of the duodenum revealed no pathological disorder. There was a questionable induration of the head of the pancreas, although this was not marked. The transverse colon and omentum were lifted so as to expose the ligament of Trietz. The jejunum appeared to be normal. In the third portion of the duodenum (the retrocecal part) a soft mass could be felt. There was no apparent extension into the surrounding tissues. In the mesentery of the small bowel, at the ligament of Trietz, there were several hard glands. One of these was removed and a frozen section was reported as tuberculosis. The small bowel, just beyond the ligament of Trietz, was clamped with Payr clamps and severed with cautery. The distal end was covered over with gauze to prevent contamination. The proximal clamp was covered with a gauze sponge.

An incision was made in the ligament of Trietz to release this portion of the duodenum. Another incision was made in the peritoneum so as to give better exposure of the retroperitoneal area. The mesentery of the duodenum was clamped, cut and tied, and with moderate difficulty, the duodenum was freed from the surrounding structures, until normal duodenum could be seen for some distance proximal to the lesion. Clamps were placed here and a segment of the duodenum approximately three to four inches in length was removed with cautery. Examination showed that we were at least an inch or more on either side of the lesion. A basting stitch of dermal No. 00 on an atraumatic needle was applied to both ends of the cut bowel. The clamps were removed. The two segments were approximated and an aseptic anastomosis was performed using an outer row of No. C silk mattress sutures and an inner row of continuous extra hard chromic No. 00. The dermal sutures were pulled out and the anastomosis was opened with a finger on either side of the stoma. There was a good opening. The posterior peritoneum was then sutured so as to make this part of the duodenum retroperitoneal.

About 2 Gm. of a mixture of equal parts of sulfathiazole microcrystals and sulfanilamide were applied in the retroperitoneal area. About 3 Gm. were placed in the general peritoneal cavity, and about 1 Gm. in the abdominal wall. Exploration of the remainder of the abdomen showed no evidence of disease either in the bowel or the mesentery.

The wound was closed in layers without drainage, using chromic No. 00 doubled continuous to the peritoneum, interrupted figure-of-eight chromic No. 0 in the fascia, interrupted silk in the skin and five stay sutures.

A transfusion was given during the operation.

Postoperative diagnosis: Deferred (pathological diagnosis was tuberculosis of this portion of the duodenum).

The pathological report submitted by Dr. B. Earl Clarke and checked by Dr. S. Burt Wolbach of the Harvard Medical School follows:—

Organ: Duodenum—third portion.

Duration: Five months.

Clinical History: Epigastric distress and some obstruction for four months.

Gross Description: The specimen consists of a segment of duodenum 7 cm. in length. It has already been opened. The circumference

at what appears to be the distal end is 6 cm. This is reduced at the opposite end over a distance of 4 cm. to a circumference of 3.5 cm. The mucosa of the narrowed portion has lost its folds. It is hemorrhagic and very superficially eroded. On section the muscular wall here appears to be somewhat thicker than in the normal part. The fibrous tissue between the muscle and the mucosa is especially thickened and more dense and white than in the normal portion. The thickness here of the entire wall is 6 mm. as compared to 3 mm. normal. The external surface is torn and ragged but in one or two fairly smooth areas a smooth tiny translucent tubercle-like nodule is visible when the specimen is rotated so as to reflect the light. There is also submitted a lymph gland measuring about 1 cm. in diameter. Frozen section of this is done and shows tuberculosis.

On the following day there was received a small segment of duodenum from the same patient. It shows considerable postmortem degeneration.

Microscopical description: Sections from all of the seven blocks potted and from the lymph gland show typical tubercles and giant cells. Some of the larger lesions show necrosis and caseation.

Diagnosis: Tuberculosis of duodenum and regional lymph node.

The postoperative course was unusually smooth, the pulse never going above 90 and the temperature returning from a high of 101°F. to normal on the fifth day. The treatment consisted of gravity drainage of the stomach through a Levine tube for forty-eight hours then sips of water for twenty-four hours. A fourth day Balfour diet was then started with the usual progression. Intravenous fluids were given daily in amounts sufficient to maintain a 1,500 cc. urinary output. The patient was allowed up on the twelfth and discharged on the fourteenth postoperative day.

Mr. S. S. returned to work after eight weeks and has enjoyed good health. He has had ultraviolet light to his abdomen and the usual vitamins. He eats all foods without any signs of gastric distress and has gained approximately twenty pounds since his operation.

Check-up x-rays were taken and the report follows:

May 20, 1943: Repeat examination of the gastrointestinal tract shows the stomach in good position and of normal outline. There was no disturbance in the peristalsis or delay in the emptying time. The first and second portions of the duodenum were well outlined and had a normal pattern but there was slight dilatation of a small segment of intestine at the site of the anastomosis, but there was no delay or obstruction to the flow of barium at this point. Other portions of the duodenum and jejunum were of normal calibre.

ISCHIOFEMORAL ARTHRODESIS WITH PSEUDOARTHROSIS*

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IT is the purpose of this paper to present the clinical result of an ischiofemoral arthrodesis in which union took place information regarding diagnosis or treatment during this period. One year later he contracted a gonorrheal infection and within several

FIG. 1. Roentgenogram of the hip prior to surgery.

FIG. 2. Roentgenogram showing the graft and the position of the fragments six months after surgery.

between the upper femoral fragment and the bone graft, while a pseudoarthrosis developed between the bone graft and the inferior femoral fragment.

CASE REPORT

The patient, a forty-three year old Italian male, was first seen in the Orthopedic Clinic in February, 1943. His chief complaint at that time was constant severe pain in his right hip which had persisted for the past eight months and which was only partially relieved by bed rest. He recalled having lifted a heavy kettle twenty years ago whereupon he heard a cracking sound in his right hip and experienced excruciating pain. He was kept in bed in the hospital for the following six weeks and was ambulatory on crutches for six months afterward. The patient was unable to furnish any

weeks his hip became stiff. He claimed that there had been no change in the deformity of the involved extremity during the intervening years.

The initial examination revealed the patient to be an obese, stocky male. He walked with a side-lurching gait. The right lower extremity had an apparent shortening of three inches, an actual shortening of one and one-half inches, and was held in 30 degrees of external rotation and 30 degrees of adduction. A 35 degree flexion contracture of the hip was present and further flexion to 60 degrees was possible. The circumference of the thigh 10 cm. above the patella was 6 cm. less on the involved side. The circumferences of the calves 10 cm. below the patella were the same.

Roentgen examination on March 17, 1943, of the hip revealed the following: "The head of the femur is badly deformed. The bone around

philes 67 per cent; hemoglobin 103 per cent, red blood count 4.66 million; urinalysis negative; Wassermann test negative.
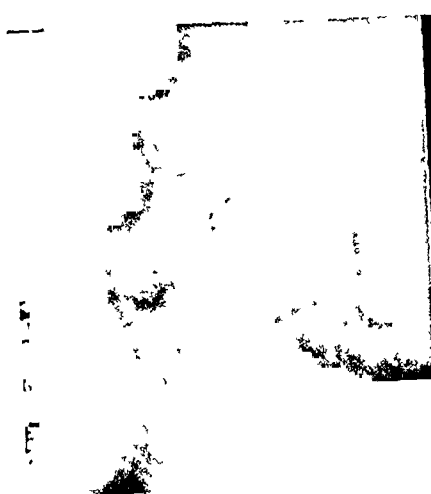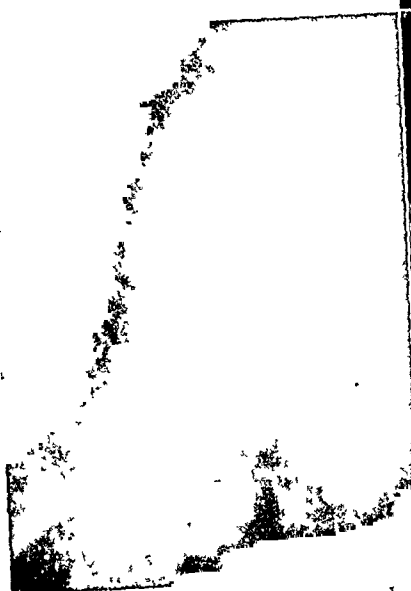

FIG. 3.

FIG. 4.

FIG. 5.

FIG. 6

FIG. 3. Roentgenogram showing the amount of abduction at the pseudo-arthrosis

FIG. 4. Roentgenogram showing the amount of adduction at the pseudo-arthrosis.

FIG. 5. Roentgenogram showing the amount of flexion at the pseudo-arthrosis.

FIG. 6. Roentgenogram showing the amount of extension at the pseudo-arthrosis

the joint is markedly and irregularly condensed and there are large sharp exostoses present at the joint margin. These changes seem to be due to an old healed inflammatory process. Chest—There is an old calcified primary lesion in the lower right lung field." The laboratory findings were as follows: Sedimentation rate, 42 mm. per hour (Westergren); tuberculin skin test positive; white blood count 12,600, neutro-

Because of the marked deformity of the extremity and the apparent activity of the infectious process in the hip, an ischiofemoral arthrodesis was performed on April 17, 1943. An osteotomy was done below the level of the lesser trochanter and the adduction and external rotation deformity corrected. A massive bone graft consisting of anterior cortical surface of the tibia was removed and sharpened

at one end. Using two osteotomes, the ischium was then fractured and the graft guided into position. The wound was closed in layers and

Fig. 7. Roentgenograms showing neutral position.

the patient immobilized in a double spica cast.

Roentgen examination of the hip taken on December 20, 1943, seven months after arthrodesis, was reported as follows: "The bone graft remains in place and is intact. The amount of callus in the lateral femoral triangle between the distal femur and the graft has increased moderately in density. It is very difficult to say whether bony union between the proximal femur and the graft has occurred although it would be safe to assume union from the distal femur to the graft. The hip appears solidly fused."

A leather and steel single spica brace was worn at home until February 1, 1944. On that day, while at home and not wearing the brace, he fell and sustained a fracture of the right external femoral condyle without material displacement. A long leg cast was applied the same day.

Fluoroscopic and x-ray examination April 28, 1944, about two months after the above injury, demonstrated that there was relative motion between the distal portion of the femur and the bone graft on abduction and adduction of the distal femur.

The long leg cast was removed at the end of six weeks and was replaced with the brace. The patient did not complain of discomfort and

FIG. 8.

FIG. 9.
Fig. 8. Sitting position.
Fig. 9 Active flexion supine.

ten weeks after the fracture of the condyle began bearing weight on the right lower extremity. He was seen regularly in the outpatient department and showed progressive improvement except for a tendency toward external rotation of the extremity.

In September, 1944, seventeen months after the operation, the patient stated that he could walk a half mile without the use of a cane. Examination showed a 10 degree flexion contracture. He was able to flex his thigh to 55 degrees and to elevate and maintain the extremity against gravity.

When last seen in February, 1945, the patient was working as a bartender. He had no hip pain and could walk more than one-half mile without tiring. He was wearing a 1½ inch lift on the right shoe which brought the crests of the ilia to the same level. A moderate limp was noted. The extremity was held in 15 degrees eversion.

Fifteen degrees of flexion contracture was present. Further motion of the hip was abduction 20 degrees, adduction 20 degrees, flexion 60 degrees, external rotation 30 degrees.

reports of Brittain, in whose series of thirty-five ischiofemoral arthrodesis three failed to fuse, but the patients had no complaints. The process through which

FIG. 10. Active abduction supine.

FIG. 11. Active adduction supine.

COMMENT

The accepted operative treatment for the unsound hip is arthroplasty or arthrodesis. Arthroplasty will produce a movable but frequently a painful hip. This is borne out by Kellogg Speed's report, which records 60 per cent satisfactory results in 225 hip arthroplasties. He sets as a standard for a satisfactory joint a hip which has 40 degrees of flexion and 50 per cent of abduction and external rotation.

A fusion of the hip can be expected to result in a stable, painless joint. Melvin Henderson, however, points out that the American patient is loath to accept a stiff hip.

A method that will stabilize the hip, but at the same time allow a limited amount of motion would, therefore, have a definite place in the treatment of the diseased hip. This is especially true when the destructive process is still active in the hip joint. The case presented demonstrates this method. That this is not an isolated instance can be seen from the

this stability and mobility was produced, can be demonstrated by the numerous x-rays in this case. The tibial graft passed through the stages of aseptic necrosis and partial absorption, but still acted as a stabilizer so that early fusion took place between the head of the femur and the acetabulum.

To enhance the possibility of creating a fusion and a pseudoarthrosis about the graft, several suggestions are offered: (1) The use of a massive tibial graft with the medullary surface facing the proximal femoral fragment; (2) fixation of the tibial graft to the upper fragment with a screw; and (3) the use of traction while the patient is in the spica cast to create slight distraction at the osteotomy site.

SUMMARY

1. A case of infectious arthritis of the hip was presented in which an ischiofemoral arthrodesis was performed according to the technic of Brittain.

2. The unusual clinical result in this patient suggested another approach to the

operative treatment of the diseased hip, namely, an *ischiofemoral arthrodesis* of the proximal fragment by a massive tibial bone graft and a pseudoarthrosis between the tibial graft and the distal fragment.

3. Suggestions were offered for the formation of the pseudoarthrosis.

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ACHONDROPLASIA is a congenital abnormality of bone formation from cartilage, with resulting deficient growth in long bones; the subjects having long bodies, large heads, and short limbs (*achondroplastic dwarfs*).

From "Principles and Practice of Surgery" by W. Wayne Babcock (Lea and Febiger).

LEFT-SIDED APPENDICITIS IN A DEXTROCARDIAC PATIENT

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THE purpose of this paper is to report a case of acute left-sided appendicitis with dextrocardia, diagnosed by ex-

with acute left-sided abdominal pain on March 12, 1944, three days before operation. Because of the fact that the pain was localized
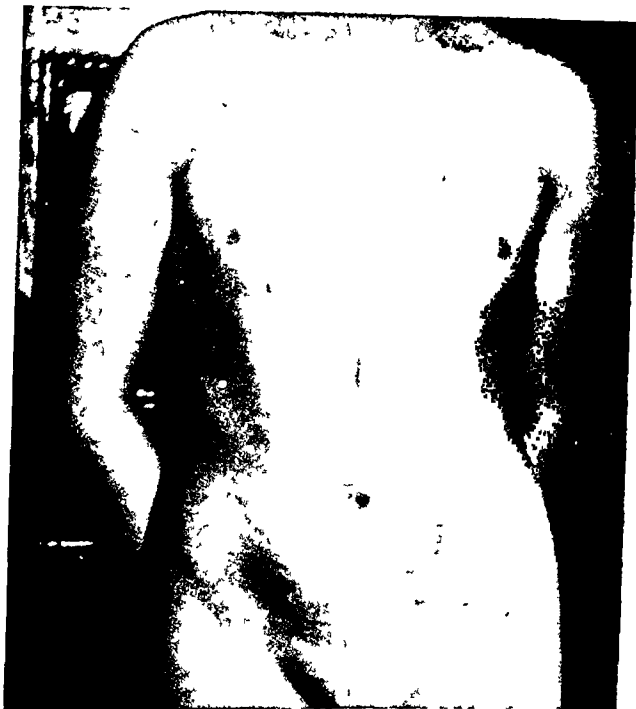

FIG. 1. Left-sided appendicitis in a dextrocardiac patient.

amination before operation. A brief review of the literature of this condition is also described.

In reviewing the literature on complete and partial visceral transposition we find that this condition is not a common one although it cannot be said to be rare. However, because this condition falls into an interesting group when surgical intervention is necessary and complicates the surgical problem involved, we believe that this condition is important enough to warrant reporting.

CASE REPORT

Case No. 8116, Revere General Hospital. E. G., a white male aged ten, was stricken

to the left of the abdomen, the child's parents did not seek medical advice. In the interim he was treated by enemas and purgatives at home. The pain was at no time referable to the right side. The pain increased and vomiting occurred. Fever developed on the second day. When seen at home by Dr. Miller on the third day of illness the child was acutely ill. His temperature was 101°F., pulse 110; respirations 30. The tongue was dry and features showed signs of dehydration. Examination of the chest revealed the heart to be on the right side, the cardiac impulse being in the fifth interspace on the right. Heart sounds were regular, rate 110, of good quality with no murmurs. The lungs were clear and resonant throughout. The abdomen was symmetrical, and moderately distended. The liver edge was felt in the upper left quadrant.

There was marked spasm and tenderness in the whole left lower quadrant. Rectal examination showed exquisite tenderness in the left lower quadrant. Routine blood examination revealed a white count of only 9,650, red blood count of 4,126,000 and a hemoglobin of 92 per cent. The urine examination was negative.

Because of the findings of an acute abdominal condition on the left side with a dextrocardia, a diagnosis of left-sided appendicitis in a case of situs viscerus inversum was made.

Operation was performed on March 15, 1944, at the Revere General Hospital. Under ether anesthesia a left low rectus muscle retracting incision was made. On opening the peritoneum free fluid poured forth. The cecum was found on the left side, revealing an acutely inflamed fibrinous covered appendix. This was removed in the usual manner and a double tie made about the stump. Sulfanilimide, 3 Gm., was sprinkled into the abdomen. The abdomen was sutured in layers with no drainage. The child made an uneventful recovery and was discharged on the tenth postoperative day.

The pathological report confirmed the findings of an acute, gangrenous appendix the lumen of which contained thick reddish pus.

INCIDENCE

A review of the incidence of partial or complete situs inversus viscerum reveals that this anomaly has been reported by many authors. In 1922, Sherk, of the Mayo Clinic, observed this condition ten times out of 347,000 admissions from 1910 to 1922. In a recent personal communication from Dr. Stuart Harrington from the Mayo Clinic, it was reported that out of 100 cases of transposition diagnosed there, approximately one-fourth received surgical treatment. Adams and Churchill state that situs inversus occurred in twenty-three cases out of 237,112 admissions to the Massachusetts General Hospital, Boston, Massachusetts. Various authors have reported that situs inversus vicerum rarely occurs alone and most always occurs with dextrocardia.

ETIOLOGY

As to the causes of left-sided appendicitis, Karewski divides the classification as

follows: (1) Total transposition of the viscera; (2) primary solitary transposition of the cecum; (3) excessive length of the appendix which extends behind the bladder transversely through the pelvis, and (4) a normally located appendix but with mobile cecum with an adhesive type of appendicitis whereby the appendix is diverted to the left side.

EMBRYOLOGY

According to various investigators, the cecum up to the third month of intrauterine life, is located in the left iliac fossa. Rotation of the cecum now occurs and ascends to locate itself in the right iliac fossa. When the phenomenon is complete, the right colon crosses the duodenum in the upper abdomen and the ileum enters the cecum from the left side to the right. If failure or arresting of the process occurs at any point, this would determine the position of the appendix.

CONCLUSION

The presence of dextrocardia should lead the examiner to make a careful abdominal examination for the accompanying presence of visceral transposition.

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MASSIVE ENLARGEMENT OF THE PROSTATE

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MASSIVE enlargement of the prostate is uncommon if the sparsity of reported cases reflect the incidence of occurrence. The symptoms produced by prostatic hyperplasia are usually sufficient to warrant investigation and subsequent treatment long before the enlargement assumes enormous proportions. The symptom producing phenomena accompanying prostatic hypertrophy are not well understood. The factors governing the position, the direction and the extent of the hyperplasia are such that they are not applicable to all instances of prostatic enlargement.

Clinically, the size of the obstructing hyperplastic tissue rarely, if ever, bears any relation to the degree of symptoms produced. A small amount of obstructing tissue may produce marked urinary symptoms, even to complete urinary retention. In contrast, a massive hyperplasia may produce few symptoms and may be found only on routine examination.

The normal prostate weighs about 23 Gm. The average adenomatous enlargement varies from 35 to 75 Gm., seldom exceeding 85 Gm. A markedly enlarged prostate is usually considered to weigh under 200 Gm. Massive enlargement of the prostate has been infrequently reported. Freyer (1906) reported a case in which the prostate weighed 535 Gm. Douglass (1927) reported a gland weighing 680 Gm. White and Gaines (1936) reported a case in which the gland weighed 397 Gm. It may be readily seen, from the number of cases reported and the intervening years, that massive enlargement of the prostate is uncommon.

The case about to be reported is unusual not only because of the extent of the hyperplasia but also due to the fact that the symptoms, although long-continued, were relatively mild. The patient was aware of the existence of prostatic enlargement for twenty-five years and at no time, until the terminal illness, were the symptoms sufficient to cause the patient to consider surgical relief.

CASE REPORT

W. A. N., an eighty-eight year old white male, was referred by Doctor George Mark because of frequency of urination of two weeks' duration. The patient complained of pain and burning on urination of several days duration. He voided small amounts of urine at frequent intervals. He was markedly constipated. The patient gave a past history of usual health until twenty-five years ago, at which time he developed acute urinary retention following a long automobile ride. The retention was relieved by catheterization. Every six to twelve months following the first episode, he developed acute retention which would be relieved by a single catheterization. He concluded that as long as the acute retention occurred so infrequently and was so easily relieved, he would do nothing further about it.

On examination, a state of acute retention existed. The bladder could be readily palpated above the symphysis.

Rectal examination revealed an enormous enlargement of the prostate that quite completely filled the rectum. Only the lower edge of the enlargement could be palpated. The mass was so large and so high that the examining finger could not begin to palpate the prostate in its entirety.

A Robinson urethral catheter was readily introduced. The entire catheter, with the exception of the distal half-inch, was necessarily inserted before urine was withdrawn. As the catheter was being introduced, a flow of bloody mucopus gushed from the catheter. There was no urine evident in the expelled

material. The catheter was further advanced a distance of two inches into the bladder and clear but concentrated urine was withdrawn.

This mass almost completely fills the pelvic cavity, causing compression of the sigmoid colon. The bowel appears to be normal in
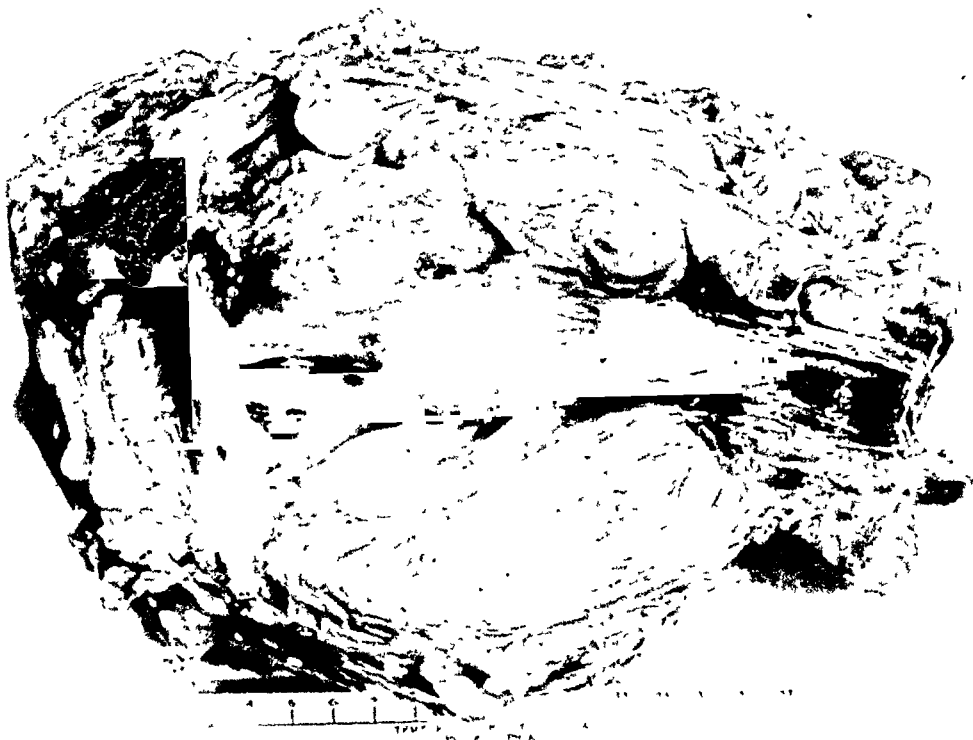

FIG. 1. The entire mass removed at autopsy included the prostate and bladder. The bladder may be seen to be pushed in front of the massive enlargement of the prostate. A distinct funnelling may be seen between the lateral lobes, which accounts for the relative ease of urination. A necrotic area may be noted at the inferior margin of the large lobes. This area is the opening of a sinus which extended posteriorly into a cavity approximately 5 cm. in diameter. The hyperplastic tissue measured 12 by 10 by 6 cm. The entire mass weighed 1,300 Gm.

The catheter was tied in and the bladder was slowly decompressed.

Following decompression of the bladder, a firm, rounded mass was distinctly palpable immediately above the symphysis. The nature of the mass was not ascertained until autopsy.

Due to the patient's greatly debilitated condition and the length to which the catheter was necessarily inserted to enter the bladder, cystoscopy was not attempted.

On admission, June 11, 1943, blood urea nitrogen determination was 17.4 mg. per 100 cc. The day prior to his death, July 2, 1943, the blood urea nitrogen was 25 mg. per 100 cc.

The report of the pathologist of the findings at autopsy is given verbatim:

"Peritoneal cavity:

"When the peritoneal cavity is opened, a large mass is found in the region of the bladder.

diameter. There is no evidence of peritonitis. Both liver and spleen are slightly enlarged but otherwise the peritoneal contents are normal.

"The Urogenital System:

"Both kidneys are considerably enlarged due to numerous large retention cysts. The left kidney weighs 240 grams, the right 560 grams. Cysts have thin, translucent walls and they are distended by considerable quantities of clear, amber colored fluid. There are two large cysts at the lower pole of the right kidney and one of these displaces the ureter and causes it to be flattened. However, there is no evidence of dilatation of the ureter proximal to this point and the pelves of both kidneys appear entirely normal. The kidney parenchyma of both kidneys is somewhat distorted by numerous retention cysts, but the kidney cortical tissue appears to be normal.

"The pelves and ureters are normal except as above described. The pubic bones are removed and the urethra, prostate, bladder and ureter are dissected out in toto. The distal portion of the ureters are normal in all respects. They empty without obstruction into a bladder of about normal size. The lining mucosa of the bladder shows no evidence of inflammation. The wall is not thickened. The bladder contains a small amount of grossly normal urine. The bladder is greatly elevated by a huge mass of tissue which is found to be the prostate. The entire mass is spheroid and when the urethra is dissected out, the mass is found to consist of two ovoid tumors each measuring 12 by 10 by 6 centimeters and the whole weighing 1300 grams. (Fig. 1.) The penile and prostatic urethra show gangrenous changes and at the level of the verumontanum there is an opening through the left posterior aspect of the urethra which leads into a cavity in the left prostatic mass. The opening measures approximately one centimeter in diameter. Its edges are ragged and necrotic and it leads into a cavity measuring approximately five centimeters in diameter and from this cavity a considerable quantity of extremely foul, clotted blood can be expressed. The capsules are not invaded and when sectioned they show what appears to be tumor tissue. The median lobe is not remarkedly enlarged."

CONCLUSIONS

A case of massive prostatic hypertrophy is presented. The total mass, which included the bladder, weighed 1,300 Gm.

The patient did not seriously complain of his symptoms until two weeks before admission to the hospital, although he had repeated but temporary attacks of acute urinary retention over a period of twenty-five years.

The finding of such an enormous gland substantiates the statement that clinically, the size of the hyperplastic tissue rarely, if ever, bears any relation to the degree of the symptoms produced.

ACUTE MESENTERIC OCCLUSION

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ACUTE mesenteric occlusion is one of the most serious, acute, surgical conditions of the abdomen. The diagnosis is often very difficult and usually is not specifically made until after the abdomen is opened. One of the reasons that the diagnosis is not made is because of the rarity of the condition.

The incidence has been very variably reported, from .105 per cent by Laufman, and Scheinberg, to .041 per cent reported by Warren and Eberhard. Whittaker and Pemberton, in 1938, reported sixty proved cases from the Mayo Clinic and Laufman and Scheinberg reported forth four cases in 1942. Other sporadic cases have been reported, some successfully treated. Undoubtedly many of the unsuccessful cases never get into the literature. Warren and Eberhard present the following outline of the Etiology of Mesenteric Vascular Occlusion:

1. Known infection: Including thrombophlebitis, appendicitis, pelvic abscesses, peritonitis and general sepsis.

2. Hematogenous causation: Blood dyscrasia or changes known to predispose to thrombosis, such as splenic anemia and polycythemia vera.

3. Traumatic: Trauma of any sort to mesenteric vessels, tearing of mesentery and trauma from abdominal operations.

4. Mechanical: Largest group. Portal stasis, pressure from tumors, pressure from adhesions or congenital bands.

"Volvulus, strangulated hernias not included."

Laufman and Scheinberg have also reported two cases that followed operation of the lumbar sympathetic chain. Lumbar sympathectomy had been performed on one patient. One of the other cases followed injection of novocain. Bauer has also reported a case in which death occurred, due to superior mesenteric thrombosis following injection of the lumbar sympathetic chain for thrombosis of the femoral vein. Welsh and Mall, in experimental work on the dog, found that if more than 5 cm. of the small intestine is deprived of arterial blood supply the segment will undergo infarction and gangrene. If less than 5 cm. is involved, the circulation is preserved by blood entering through each end, by way of the intramural channels.

The symptomology is not always clear. The picture is usually that of an acute abdominal emergency. Acute intestinal obstruction is most often suspected. However, the pain is usually out of proportion to the physical findings. Shock is also usually pronounced. The important thing is to recognize that an acute, abdominal emergency exists and to proceed promptly with operation, for delay is one of the reasons for the published high mortality.

In the reported series, the diagnosis was made preoperatively in about one-fourth of the cases. Of course, many of the patients have other serious conditions such as heart disease, kidney disease, or liver disease, and often are moribund when the final catastrophe takes place. This is another reason why the mortality is so terrific. The published mortality has varied in the larger series of cases from 84 to 90 per cent.

The only treatment is prompt operation with resection, and resection should be carried out well beyond the area where there has been interference with circulation. In our reported case, five and a half feet of the intestine were removed. About

four and one-half feet of it was completely black, and about six inches on each side showed interference with circulation. Resection was carried well up into good intestine. The point which is very important is that thrombosis may continue in the partially devitalized area and gangrene actually occur in that area later. If one cannot be sure of the circulation in the end involved, it is better to close the end of the intestine and make a lateral anastomosis rather than do an end-to-end anastomosis.

CASE REPORT

The patient was a white male, age forty-two, a shipyard worker. In September, 1944, he had polyarthritis. A superficial phlebitis of the left leg was also present; it never became very extensive. In December, 1944, he was seen by his family physician and was found to have a good deal of evidence of kidney disease, as shown by albumen, casts and red blood cells in the urine. His arthritis at that time had pretty well subsided. The phletitis had completely subsided. He had some very badly infected teeth, and in January, 1945, two of these teeth were extracted and almost immediately he developed clinical signs of pneumonia, bilateral basilar type. He was extremely ill but finally, under sulfanilamide therapy, made a slow recovery. No x-ray was ever made because he was never hospitalized. He had gotten over his pneumonia and began to get around. There had been some complaint of intermittent abdominal pain, which was never characteristic; and although appendicitis and cholecystitis had been suspected, a true diagnosis could not be made because of the indeterminate nature of the symptoms. He seemed to be making a slow recovery and was getting around recovering strength and had been to his doctor's office on the morning of March 25th.

That afternoon he went to a movie and while he was at the movie he was suddenly seized with terrific abdominal pain. This occurred at 6:30 P.M. and he summoned his family doctor. A diagnosis of an acute abdominal emergency was made. It was suspected preoperatively that he had a small appendiceal abscess, which he had been walking around with, which had ruptured and caused a fulminating type of peritonitis. He was suffering extreme pain, was in

moderate shock, had a generalized abdominal rigidity, his blood pressure was normal and his temperature was 101°F. His leucocyte count was 13,000. All of the possibilities of causing such a syndrone were mentioned, but no true diagnosis could be made. The most likely thing seemed to be in reference to his appendix. The abdomen was opened within two and a half hours after the onset of his symptoms and a gangrenous intestine, which actually measured five and one-half feet after it was removed, was found. The mesentery was thickened, rubbery, and gave the impression of a fairly long standing inflammatory process. Resection was carried out close to the bowel wall and sections of the mesentery revealed no evidence of tumor. An end-to-end anastomosis was made and the opening in the mesentery closed. Continuous Wangensteen suction was instituted. The patient was given intravenous fluid, 3,000 cc. a day. He was given 500 cc. of blood immediately after operation.

His condition remained satisfactory throughout. He had a very easy, almost uneventful convalescence. He had, at no time, become very distended and his general condition rapidly improved. He was allowed to be out of bed on his eighth day, and left the hospital on his fourteenth day after the operation, having been up walking around the ward for two or three days previously. His condition since that time has continued uninterruptedly. Two months after operation he was dismissed for work at the shipyard.

COMMENT

This patient undoubtedly had an acute arterial occlusion as judged by the very sudden onset of the symptoms, with the severity of the pain quite striking. The pain itself was quite shocking. We believe that the success of this case was due to the promptness with which the surgical attack was carried out. However, the mechanism whereby the process came about, certainly is not clear. It is thought that the embolus might have come from the pulmonary circulation following his recent bout of pneumonia. In fact, his clinical pneumonia may have actually been multiple infarctions of the lung. It is surprising how well he stood such an extensive surgical procedure at this time,

yet only just several months previously had had such a terrific time following extraction of only two teeth. One of the very interesting things in surgery is how the risk involved and the procedure varies from time to time, and also how the symptoms and pathology often do not parallel.

SUMMARY

A case of successful resection of sixty-six inches of the ileum for acute mesenteric occlusion is reported.

The prompt resection was the chief reason for success.

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Bookshelf Browsing

THE CLINIC OF LAWSON TAIT OF BIRMINGHAM IN 1884*

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YEARS ago, Elbert Hubbard wrote a number of "Little Journeys," some to the homes of great musicians, some to the homes of great poets, some to homes of the great and of the near great, but he neglected to write "Little Journeys" to the homes of great physicians.

To us physicians what could be more interesting than to study the lives of those other physicians who have found prominence, who have done good, who have served their country and who have taught as true physicians, their followers.

As we look through the lives of the great physicians of our country, we find some who have followed in the footsteps of illustrious Sires and who have carried the banner of public service as a family tradition and as a result of family upbringing. We find others who in spite of adversity, in spite of family handicaps, in spite of burdens of debt on young shoulders, in spite of discouragement have overcome every obstacle and reached a pinnacle in their chosen life work so high and outstanding in comparison with their early childhood as to outdo Alger in his wildest dreams. Such a one was George Ryerson Fowler. Born December 25, 1848, of humble parents, his public schooling stopped at a tender age, earning at the age of twelve, $3.00 a month, his food and the privilege of sleeping under the counter of a neighborhood store. He was a telegraph operator at night at the age of fifteen and a mechanic's helper in the day time, saving his money with the object of becoming a "doctor." This latter ambition had been implanted in his mind on seeing a fatal accident, a traumatic amputation of the leg with death from hemorrhage on the Long Island Railroad, fatal through lack of proper immediate treatment.

In 1884, George R. Fowler visited the clinics of Europe and I have been fortunate in receiving the diary of that visit on which this paper is founded. Among other clinics visited was that of Lawson Tait, then at the full height of his successful career.

Lawson Tait was by some thought to be the illegitimate son of Simpson. Simpson, according to one biographer, failed frequently like Henry Ward Beecher, to observe one of the Ten Commandments. On one occasion Tait was asked by his then assistant, McKay, whether there was any truth in this story. Tait leaned back in his chair, pushed his stomach out, pulled a lock of his hair over his forehead, and looking at McKay asked him what he thought. There certainly was a marked resemblance between Simpson and Tait. Tait had lived at Simpson's house and had been his student, and on Simpson's death Tait was given the papers and notes in regard to hospital mortality which was unfortunately cut short by Simpson's death. Simpson's son placed the papers in Tait's hands, but he did not find much that he could use. In fact, in studying the original returns from hospitals he is quite suspicious of either intentional or careless misstatement. Later on, Tait did make a study of hospital mortality which he

published in 1877, dedicating the book to the memory of a great master, James Young Simpson, whose effort is dedicated by a grateful pupil. This study was the first made of the statistics of hospitals of Great Britain for fifteen years. Tait points out that the figures showed incontestibly that a more stringent inquiry is demanded as to the possibility of reducing the number of deaths in at least some institutions for the treatment of the sick poor.

Tait's life and work, his perseverence and skill, his honesty and fearlessness, his indomitability, his strength of mind and body, make him admired by surgeons.

He thought he could not teach, as witness his remarks about public clinics in his visit to Canada and the United States. Yet he did teach, and his teaching opened up to many the wide vistas of modern abdominal surgery.

Robert Lawson Tait (Edinborough 1845–1899) is better known as Lawson Tait of Birmingham where he settled in 1871. Here came to him patients from all over the continent and surgeons from all over the world. Tait argued against Listerism, denying that bacteria are pathological. He relied upon mechanical cleansing with soap and hot water, to which his marvelous success in ovariotomy was due.

In Greig Smith's* Abdominal Surgery, there are forty-five references to Tait, many more than to any other author, showing the diversity of his work and genius.

Though primarily a gynecologist, Tait was also a great general surgeon. To Lawson Tait belongs the credit of introducing and establishing the operation of hepatotomy. He had done this operation ten times when his work was published, nine times for hydatids and once for abscess. All were successful. Our own William Mayo's estimate of Tait was that he was the father of modern abdominal surgery.

As a gynecologist Tait played a great part in the development of the operative

* Greig Smith, Vol. II, Page 972.

principles which had been established by McDowell, Sims, Emmett, and Battey in America, Koeberlé in France, Gustav Simon in Germany, and Sir Thomas Spencer Wells (1818–1897) in England. His success in operating was marvelous, so much so that at times his statistics were questioned but they were always proven true. His abdominal sections numbered by the thousands, with rarely a death. He never used any antiseptic precautions. The secret of his success was undoubtedly his rapid, skillful technic and cleanliness and the use of warm or boiled water to flush out the abdomen. He antedated Von Bergman in the development of what later became known as asepsis. He would allow no finger to the wound but his own so that although he did not acknowledge the causal relation of germs, yet he guarded against them. Tait performed the first successful operation for ruptured tubal pregnancy (January 17, 1883), was the first to work out the pathology and treatment of pelvic hematocele, and, in his "Lectures" on these subjects (1888),* he points out that the first authoritative treatise on extrauterine pregnancy was written by John S. Parry (1843–1876), of Philadelphia (1876). In 1879, Tait excised the normal ovaries,† along the lines laid down by Battey (1872–1873), but claimed that in none of his cases were the uterine appendages normal. This, with the similar operation of Alfred Hegar in 1877, developed, says Kelly, "the whole field of pelvic operations for diseases of the organs other than gross ovarian and fibroid tumors." "The peri-uterine phlegmons of Emmett and Thomas became recognized as tubal inflammations and abscesses." In 1879, Tait performed cholecystotomy, excision of hydrosalpinx and pyosalpinx, introduced his flap-splitting operation on the perineum, and his methods of dilating the cervix and of replacing the inverted

* Tait: Lectures on Ectopic Pregnancy and Pelvic Haematocele, Birmingham, 1888.
† Brit. M. J., London, 1: 766, 1881.

uterus. In 1880, he introduced hepatotomy, and, in 1881, he devised the special operation for excision of the uterine appendages by securing the pedicle with a silk ligature, tied by means of his invention, the "Staffordshire knot." His method of "flapsplitting" in plastic repair of the perineum was a valuable innovation (1879), but it was not taken up in America for a long time. Tait left interesting summaries of conclusions from his operative statistics, treatises on diseases of the ovaries (1873) and diseases of women (1879–1889), and highly original essays on rape and other subjects connected with medical jurisprudence. In all these productions, he is a forcible, effective, frequently coarse, but always an amusing writer (Garrison).

Perhaps Tait's personality is best explained by quoting from the introductions to some of his books. One of the last, written in 1897, was at the request of McKay, who dedicated his book on perineal operations to "Amico Optimo, Praeceptori Sollertissimo, Lawson Tait."

"I have complied with the request of my friend Dr. Stewart McKay, to read the following pages and add a few notes, with much pleasure, because his description of my perineum operations are the first which I have seen full enough to be of any use to those desirous of doing these operations as I wish them to be done. This is probably to be attributed to a want of fullness or clearness in my own descriptions; a fault due to the fact that writing is to me an intolerable labour, and my attention has for years been closely occupied by matters which seemed to me more important. Besides, those who had seen me do the operations comprehended them so readily, carried their instruction away with them and reproduced it so perfectly, that the difficulty of understanding descriptions of them seemed to me only absurd.

"Yet, it must have been real, for I find my operations mixed up with those of other people in confusion most inextricable. I have seen a description of something

called 'The Tait-Sänger operation' for which I desire to disclaim all responsibility, as with all similar mixtures. The difficulty of understanding alike my own description and some dozen others published in recent years appears at its height when Dr. Howard Kelly, in his article in Dr. Matthew Mann's 'System of Gynaecology,' considerately refrains from any allusion to the operations. Yet when seen and understood they are the simplest, neatest and most effective operations in surgery, have a fatality of certainly not more than one in five hundred, and their failures, in my own hands, are not over two in some thousands. Those failures were due to previous denudations.

"I think Dr. McKay's ingenious diagrams and carefully detailed description will bring the understanding of these simple proceedings within the reach of all."

Rarely does a preface disclose human characteristics so well, *appreciation* of McKay who was so long associated with him; *modesty* as to his own written teaching; *dislike* for writing; excellent clinical teaching; the ability to pass on technic to others; sarcasm as to Kelly's omission of the operation; and appreciation of his own ability and the excellence of his work.

Lawson Tait was so well thought of by his American colleagues that a résumé of his original work on extra-uterine pregnancy was read and lauded at a meeting of the American Association of Obstetricians and Gynecologists, held in Philadelphia, in 1888, as part of a symposium on extra-uterine pregnancy. Speaking at this meeting were Drs. Franklin Townsend, Joseph Price, E. E. Montgomery, W. H. Wathen, John B. Deaver, L. S. McMurtry and A. Vanderveer. Most of you undoubtedly remember Deaver, still many remember Vanderveer, and a very few McMurtry. All of you will recognize all the names as prominent ones in gynecology. I personally knew Deaver, McMurtry and Vanderveer, all good friends of G. R.'s. McMurtry and Vanderveer always visited our home when in New York.

The directness of the man is shown in the preface to "Diseases of Women," published in 1877, and dedicated "To Thomas Spencer Wells, in admiration of the brilliant work by which the art of surgery has been enabled materially to prolong human life." The preface written in 1877, reads in part as follows:

"Although Gynaecology has engaged the attention of many very able writers, it must be admitted that there is within its scope a great deal upon which our information is still far from being either complete or accurate. I must plead, therefore, that any new effort to extend our acquaintance with the special Diseases of Women deserves at least to be received with patience.

"Concerning some of these diseases I have ventured to advance new views, both of their pathology and their treatment, and towards these criticism may fairly be directed; but I can claim for most of them that they have already been published in the form of occasional papers, and have been well received by those whose opinions are of the greatest value.

"My chief object in this book has been to offer the results of my own experience in as condensed a form as possible; and I have therefore avoided, as far as I could, long quotations, needless reference, and detailed accounts of cases. I have also refrained from introducing illustrations of pathological appearances, for I have rarely found them to convey any very intelligible idea of the facts, unless in the form of costly lithographs; and the use of these would have greatly enhanced the cost of the book, without giving a corresponding increase to its value. The chapter on Diseases of the Ovary is an enlargement of my Hastings Essay of 18-3."

Tait's humanity is further shown in his preface to his translation of the second German Edition of "Children's Diseases," by Steiner, in which Tait writes in October, 18-4:

"I have added as an Appendix the 'Rules for Management of Infants' which have been issued by the staff of the Birmingham Sick Children's Hospital, because I think that they have set an example by freely distributing these rules amongst the poor for which they cannot be sufficiently commended, and which it would be wise for other sick children's hospitals to follow."

Tait's fairmindedness is shown in the preface to the 1883 (second) edition of "Diseases of the Ovaries" in which he writes in 1882, in part, as follows:

"I have found reason to change my opinion on some points, but they are of much less importance than I thought they would be when I first sat down to write these pages. I have seen far more reason for extending what I had to say; for the marvelous success which now attends the efforts of those who practice abdominal surgery has fallen largely to my lot, and therefore records of things accomplished, and opinions expressed upon them, will be found in these pages, which, eight years ago, were certainly beyond the limits of acceptance. Since then, however, great advances have been made, but much yet remains to be done, and all must rest upon the patience of the workers and the forbearance of their critics.

"For many imperfections of my book I have to offer the apology that I have but scant leisure for research, and fear I may not have done justice, in many instances, to the work of others. My writing is chiefly the outcome of my own experience, and of necessity is freely and unavoidably scattered with the pronoun of the first person."

He dedicated this work to Marion Sims, as follows: "Dear Dr. Marion Sims, I Dedicate THIS VOLUME TO YOU AS A TOKEN OF THE VALUE I PLACE UPON YOUR FRIENDSHIP, AND AS AN ACKNOWLEDGMENT THAT MUCH OF THE NEW WORK DESCRIBED IN IT IS THE OUTCOME OF YOUR INGENUITY. Yours Truly, LAWSON TAIT."

Tait's desire to give credit where due is shown in his contribution, CHOLECYS-TOTOMY in which he writes:

"Dr. Marion Sims attributes to Dr. Handfield Jones and I think correctly, the merit of first suggesting that the liver and gall-bladder should be included within the field of surgical practice more fully than they had been up to that point, and particularly that surgical interference should be made in cases where death is threatened from the impaction of a gall-stone.

"To Dr. Marion Sims himself must be given the credit of having followed out this suggestion with his usual boldness and ability, and he himself points out that the case in which he did it was not successful only because the operation was too long delayed.

According to Greig Smith, the modern operation of cholecystotomy was first performed by Dr. Bobbs of Indianapolis in 1867, who incised the gallbladder, removed some fifty small calculi and closed the incision with one suture. His patient recovered. Marion Sims followed with an operation which, though unsuccessful, had a most important influence in advancing the surgery of the gallbladder. Sims originated the name cholecystotomy.

The preface to "Diseases of Women and Abdominal Surgery," 1889, Volume I, shows the way in which Tait's previous efforts had been received by some, and the spirit with which he met criticism. It is to be noted that his titles at that time were many, and including American titles as well. In the preface written in Birmingham, April 16, 1889, he says:

"In the preface to my first work of this kind, which appeared in 1877, I urged a 'plea that any new effort to extend our acquaintance with the Special Diseases of Women deserves at least to be received with patience.' This plea was, to a very large extent, disregarded, and the method in which my little effort was received was speedily manifested in two wholly different and, I am bound to state, wholly unex-pected directions. The first direction to be indicated is, of course, the most extended, and that consisted of ridicule, abuse, and misrepresentation.

"The second direction was to me, however, far more important, and I soon ceased to trouble about the other. A small band of younger and more earnest men came to see and judge for themselves, and were speedily converted to the belief that a new field of work had appeared; and many who had started with a sneer at the 'Birmingham School of Gynaecology' remained to speak of it with respect, to adopt its methods, and become its earnest and progressive disciples.

"It is curious, as a mere little bit of history, to read the reviews of my work of 1877, and to read as a contrast the impression it has created in ten years as indicated in the pages of such a masterly work as Greig Smith's book on Abdominal Surgery, 1887.

"What I am now saying must of course appear as the outcome of egotism, but I must give it as the reason and explanation of much I have to include in the present work, and as a justification for my expressions of unbounded gratitude to the members of the American medical profession who have done so much to aid me in what has been accomplished. To many continental friends—Italian, French, Danish, and a few German—I have also a debt of acknowledgment to offer for their support and their candid acknowledgment of the value of what they have seen for themselves.

"During the period of these ten years Gynaecology and Abdominal Surgery have made marvelous advances. The old-fashioned school—the teaching of the speculum, the sound, the caustic stick, and the pessary—has been practically killed, and an advanced eclecticism now prevails. This has largely grown out of the wonderful revelations obtained by the experiences of operative surgery. In 1877, Spencer Wells left ovariotomy where it had been for half a century before him, with a mortality of

one in four. Now it has a death rate of a little more than three in a hundred, and this fact alone has given an impetus to and a facility for the alleviation of suffering in other directions, of the value of which the most enthusiastic estimates that have yet appeared, probably fall quite short.

"The present work professes to deal with 'Diseases of Women and Abdominal Surgery,' a title which records the historical fact that the evolution of abdominal surgery has proceeded entirely from the necessities of the special diseases of women, and their combination is now so complete that it is unlikely they will ever be again separated. The day has gone by when the treatment of pelvic and abdominal diseases, so prevalent amongst women and relatively so rare amongst men, was regarded as a mere appendix to the work of the accoucheur. It has gone as completely as the day when diseases of the eye were dealt with in a chapter appended to a text book on the practice of medicine. Gynaecology and obstetrics are now happily severed, and this division of labour has resulted in enormous advances for both.

"In the plan of the present book I have followed the scheme of my first publication. 'My chief object is to offer the results of my own experiences in as condensed a form as possible.' If the present edition is to have any value it can arise only from what I have to say of my own work. If I fail there I do not care to succeed by padding it with extracts from the work of others. Nor can I imagine it possible that any modern gynaecologist, whether he accepts my views or not, could conscientiously say that my work has not been extensive enough to entitle me to express my convictions concerning it."

To read this volume with the understanding of experience is indeed a treat. It is most extraordinary and wonderful in its teaching and refers to associated subjects in a charming manner. The man must have been both quite humorous, human and humane, as well as wonderfully

balanced. He knew a great deal of medical history and had an enormous amount of common sense. He sometimes drove a point home in a manner, which in those days was not considered dignified; for instance, Tait reproduces a picture of a tombstone and epitaphs and remarks speaking of repeated tapping of ovarian cysts.

"I found recorded on tombstones in the churchyards of Romsey, in Hampshire, and Bunhill Fields; and I leave the epitaphs to tell their own story, doubtless in these instances quite veracious.

In
Memory of
FANNY DAWKINS
who, after, five Years
soothing the Afflictions
of an aged MOTHER,
fell "asleep in JESUS,"
April 29th, 1826.
Aged 57 Years.

Also, MARY DAWKINS
Mother of the above
who having been tapped
for Dropsy 46 times
reposed in Christ, Sept. 1,
1826.
Aged 90 Years."

In Bunhill Fields is the monument of a courageous lady, whose memory is thus perpetuated. On one side of the tomb we read—

"Here Lyes Dame Mary Page,
Relict of Sir Gregory Page, Bart.
She Departed this Life March 11, 1728.
In the 56th Year of her Age.

And her fame rests on the inscription on the opposite side—

In 67 Months she was Tap'd 66 Times,
Had Taken away 240 Gallons of Water
Without ever Repining at her Case
Or ever Fearing the Operation."

I now quote from George R. Fowler's diary:

"Friday, May 16, 1884. Letter from Lawson Tait. In afternoon Kings College Hospital, no operations. To Meyer Meltzer Instrument makers. Bought 4 dozen needles and certified thermometer. 5:30 train to Birmingham, Queens Hotel.

"Saturday, May 17th. Called on Lawson Tait. The Crescent Private Hospital and residence adjoining houses. Saw him remove ovaries and Fallopion tubes for a small myoma. Operation about 25 minutes. Short incision, silk ligature of pedicle, silk sutures, complete closure of abdominal wound. No antiseptics. Instruments in water bath. Showed me about 24 cases of recent abdominal section, all doing well. In one case where hysterectomy had been done stump was suppurating freely as well as the abdominal wound. Stank. Dressed with dry lint.

"Afternoon—Stratford-on-Avon, tomb and birthplace of Shakespeare. Warwick and Castle via Charcote Park. Leamington to London by 6:00 o'clock train.

"Sunday, May 18th, Westminister Abbey Services. Sat under new bust of Longfellow.

"Afternoon—Dined with Mr. Messent at Peckham.

"Monday, May 19th. Birmingham on 2:30 train. Dined with Lawson Tait and afterwards accompanied him and his wife to the theatre.

"Tuesday, May 20th. Case of large myoma removed by hysterectomy at Birmingham Hospital for Women, by Mr. Tait. Operation lasting 35 minutes. M₁. Savage present, Pean's clamp and transverse pins to support the pedicle, peritoneal covering drawn over cut surface of stump and a few crystals of thymol placed under this covering so formed (Bontock's method, the thymol being Tait's idea). Dressed with absorbent cotton. To London 11:30."

It was during these visits to Tait that Doctor Fowler saw Tait operate for ruptured perineum and made the following notes:

"*Lawson Tait's operation for ruptured perineum as shown and demonstrated upon a patient by him for me:*

"First split up the remains of the perineal body upon the faces of its two halves to the full depth or thickness of its tissues, about midway between where the posterior commissure of the vulva should be, and the posterior limit of the rent, whether it, (the rent) includes the sphincter and rectal wall or not. Run this incision or 'split' up for an inch and a quarter or an inch and a half, upon either side. Then make an incision at right angles to each of these for about three quarters of an inch upwards, where their outer or nearest extremity joins the integument of the buttocks. A similar incision is made running downwards (patient on back) so that, upon the face of the rent upon either side there is a ⊤ shaped incision. Now dissect up the flaps so formed to a sufficient extent to get a good broad surface for union. This is all to be done with scissors. The upper triangular shaped flaps are turned upwards so as to close vaginal canal upon its floor, and the lower ones are turned downwards while the denuded surfaces from which they are reflected are brought together.

"The sutures: The first suture is the middle one. This commences where the *raw surfaces join the integument* and passes directly down to the bottom of the first incision. The second one is passed in like manner just above it and the third one below. This latter must come below level of sphincter, if the rupture is complete. These sutures should first, approximate the raw surface left by dissecting up the flaps, and second, the raw surface of the reflected flaps themselves. *In no case should a suture show either in vagina or rectum.* Now the upper angles of the flaps are joined by a superficial suture, and perhaps the lower angles likewise. Sutures Nos. 1, 2 and 3 of silver wire; superficial ones of silk. Bowels kept loose. Sponge in rectum during operation."

BIOGRAPHY OF JOHN HUNTER

R. A. LEONARDO, M.D.

ROCHESTER, NEW YORK

FEBRUARY 9th marks the birth of John Hunter of London, the father of experimental surgery. Because of the lack of knowledge of the average surgeon on historical matters, it seems appropriate to give a brief résumé of his life.

In the eighteenth century England was rapidly becoming the surgical capital of the world, and its most shining light was John Hunter (1728-1793). He ranks with Paré and Lister as one of the outstanding surgeons of all times.

Glancing at the London scene of 1748, we could have seen a short, thick-set, red-haired young man of twenty with a violent temper, freshly arrived from the Scottish provinces to seek his fortune. His name was John Hunter. The youngest of a brood of ten, he had lost his father when a boy, depriving him of any chance for an early education. He was in London to find employment or to enter the army. His older brother William, who had already established the first real medical school in London, took him on there in the dissecting room, trained him, and also opened for him opportunities to study under Cheselden and possibly also under Percival Pott, the most famous surgeons in England. Young John also attended Oxford, but hated it and left in less than two months, always referring contemptuously thereafter to the "stuffing with Latin and Greek."

After returning to his brother's establishment, in 1756 he obtained a post in St. George's Hospital similar to that of a modern house-surgeon. This hospital association was to last the rest of his life. As he threw himself enthusiastically into his work to make up for lost opportunities, his health suffered and in 1761 he had to become an army surgeon to get the change of climate he needed. In this capacity he

spent two years abroad, part as surgeon in the hospital in Belleisle (against which the English had launched an expedition, in the endearing custom of those days), and part in Lisbon. In military surgery, like the great surgeons of all times, he received invaluable training. By his return he had recovered his health, gathered a mass of material for his treatise on gunshot wounds, and made the acquaintance of his future wife's family, the Homes. Hunter was never one to waste time.

Back in London, he lectured on practical anatomy and operative surgery, and took up his experiments on animals with his old enthusiasm. He even built a house to keep them in; he was, by the way, very fond of them, especially the fiercer ones, and took pleasure in wrestling with them.

In December, 1768, after many disappointments, he finally achieved the coveted appointment as surgeon to St. George's Hospital. For the next twenty-five years Hunter worked at a tremendous pace. His time was divided between his pupils and numerous apprentices, operating at St. George's, building up his museum, and his tireless researches in anatomy and pathology. He studied and described surgical shock, phlebitis (which he believed to be the cause of thrombosis, disproved by Virchow in 1852), pyemia, inflammatory processes, and the lymphatics. He discovered the lacrimal ducts in man, and was the first to differentiate between hard and soft chancre and to study the teeth scientifically.

An indefatigable worker, he usually got along on four hours' sleep a night, and the breadth of his interests produced researches, side by side, on the effects of smallpox on pregnancy and the plumage of hen-pheasants. These interests may seem unrelated to surgery, but actually

they were the essence of what John Hunter stood for in surgery and the groundwork of all his contributions—the application of the experimental method to surgery. Before Hunter Cheselden had raised surgery, particularly his specialty of lithotomy, to its highest skill. Hunter found surgery an art and left it a science. Anatomy, pretty well mastered by that time, was not enough, he taught; the surgeon must know physiology, the processes, causes and sequence of the morbid changes necessitating surgery. And these changes could be revealed by experiments on animals. For instance, his own operation for popliteal aneurysm was made possible because he had once tied off the main artery to one antler of a deer. Instead of the expected necrosis and gangrene, the blood supply continued to supply the antler through subsidiary arteries which enlarged and completely took over the function of the unused vessel. By other experiments Hunter had established the principle that coagulated blood was absorbed by the body provided no fresh blood was allowed to enter the chamber. On the basis of these discoveries on animals, he was enabled to tie off the popliteal artery well up the thigh, in healthy tissue, and let nature do the rest. He found the surgery of aneurysm in a primitive state and left it in a finished one. Before Hunter's time the old method of Antyllus had been used, namely, tying off the vessel above and below the aneurysm and then evacuating the sac. The mortality was so high that many surgeons of Hunter's time preferred Percival Pott's method of amputation above the tumor.

Hunter is believed to have been the first to give food and medicine through a stomach tube.

Hunter's insatiable curiosity led him to inoculate himself with pus from a gonorrheal patient, in which were also, unknown to him, the spirochaetes of syphilis. He watched and took careful notes on the course of the disease in himself, treating his lesions with mercury ointment. But eventually it centered in a generalized infection of the blood vessels, ascribed by many of his biographers to angina pectoris. This rendered him peculiarly susceptible to any undue physical or emotional stress, and eventually he was carried off by a fit of anger in an argument over the admission of some of his students to St. George's Fittingly enough, he ended his career at the institution with which he had been so closely associated all these years.

This day in 1793 marked the end of a great and versatile surgeon, anatomist, and zoologist. From his pen had poured innumerable papers in both medicine and biology, among the best being the "Treatise on Venereal Diseases" for which he paid so dearly, "Observations on Certain Parts of the Animal Economy," and his crowning achievement, "Blood, Inflammation and Gunshot Wounds."

His influence was enormous also because he trained students in his experimental methods. His pupils, of whom Jenner was one, included all the great surgeons of the next generation, and they introduced his principles, dismissed as dreamy and theoretical by his contemporaries, everywhere they went in Europe and America.

He amassed and prepared, mostly with his own hands, a collection of 14,000 specimens, now in the possession of the Royal College of Surgeons of London. Thanks to him this museum ranks first in the world in comparative anatomy and zoology.

CORRESPONDENCE*

GLIMPSES OF VASCULAR SURGERY ON THE CORAL REEFS
OF THE SOUTHWESTERN PACIFIC

AT the time of this writing (during the fierce fighting at Okinawa, the Philippines and other battle fronts of the Pacific) every scrap of information that will tell of the experience, hardships and achievements of our heroic war-surgeons is interesting and informative.

This is particularly true of the war wounds of the blood vessels which, in many instances, still challenge our best efforts to save life and limb from their destructive effects, even when they involve only the peripheral arteries of the extremities. From this particular point of view, war wounds of the popliteal vessels are especially important. Their progressive increase in frequency and gravity has become one of the most conspicuous features of the two world wars. But in World War II destruction is far greater. All the missiles, implements, machines and methods of destruction by explosive shells, the fragmentation of bombs, torpedoes, buried ground mines, machine guns, hand grenades, etc., tremendously multiplied and perfected, are now directed to their human targets from the ground, the sky and the sea, thereby increasing the mortality of the central or visceral wounds and the crippling effect of the peripheral wounds of the extremities. Wounds of the popliteal vessels have the most disastrous effects on the lower limbs and the increase in the number of amputations caused by the popliteal injuries has been noted all along the North African, Italian, French and German campaigns. The evidence accumulated in the battles of the Pacific show that while there has been great improvement in life saving (by blood transfusion, especially) the popliteal wounds still remain a grave liability.

It is from this special viewpoint that observations contributed by Commander Holman are pertinent and important as they bear the stamp of his great competence and authority:

January 20, 1945. "On this 2 × 4 coral island in the Western Pacific, where we have been establishing a 1000-bed base hospital. First housed in tents, we have just moved into more comfortable Quonset huts, whose wooden floors are very welcome after four months on the sand and coral. It seems ages ago that we landed here, and the memories of those early hectic days are fast receding into the limbo of the past: the torrential rains with only pup tents for cover, the rivers of mud called roads, the jungle swamp chosen for our temporary camp site with its all-pervading odor of decaying Japs (and Marines), with its denuded skeletons protruding from mudsoaked uniforms, the ear-splitting roar of nearby howitzers and mortars, the whistling shells, and the zing of bullets that made one duck one's head involuntarily, raising it again, sheepishly, when one realized that nothing had happened (that time!).

"On arrival here on D-12 we were temporarily assigned to help the overworked surgeons of the Marine medical companies; we received our wounded direct from the battlefield not more than 800 yards away but from which we were protected by a ridge. The battlefield consisted of ridges with intervening valleys and innumerable caves—to oust the Japs from such terrain took many lives, many casualties and months of fighting!

"Some interesting *blood vessel injuries* have been encountered, *not only here,* but while stationed at Vella la Vella during the Bougainville campaign, and while on the U.S.S. Tryon during the Saipan-Tinian strike. As usual, *injuries* to the *popliteal vessels* proved most dangerous to life and limb. Of eight wounds of the popliteal space, six were followed by amputation and 1 of these died from ascending gas gangrene. Two died of g. gangrene without operation.

"Major J. M. Parker of the Army wrote me last May that in twenty cases only three limbs survived popliteal ligation. One of the invariable accompaniments of popliteal artery injury was the early development of an extensive, firm edema of the calf muscles which then rapidly became indurated, *presenting a structural alteration that was hard and unyielding and which undoubtedly prevented the opening up of an effective collateral circulation.* In two instances we split the skin and fascia longitudinally from popliteal space to ankle. The tight skin spread apart remarkably but it failed in its purpose—gangrene developed as usual. In one instance, I attempted an anastomosis without heparin—and it failed.

"In another instance *ligation of both anterior and posterior tibial arteries—leaving only the peroneal—was not followed by gangrene.*

February 26, 1945. "We have had no experience with Blakemore's tubes—nor are any available here, but in order to be prepared for the emergency, I have written for some. Heparin has also been lacking in the field.

"Last November during the Bougainville campaign I attempted *a popliteal repair* on a twenty-four-hour old injury with incipient dry gangrene of the toes hoping to limit the gangrene and enable us to do a below-the-knee amputation. At the time of operation there was no evidence of gas gangrene, and smears taken at the time were negative—so we repaired the vessel. Forty-eight hours later a cast applied to keep the knee in flexion was removed because of fever, and the thigh showed extensive infiltration with gas—amputation was performed—followed by death! It is such experiences in the field that make one reluctant to do much blood vessel repair: better a live patient with no leg than a repaired vessel and death!

"We have tried *refrigeration* in five patients—carefully noting the level of impaired circulation before refrigeration. In none was there any *extension of the* impaired area, but also there was no improvement nor evidence of revascularization of the impaired area, so that *amputation was necessary at the same level indicated even before refrigeration.*

"An interesting experience with *lumbar sympathetic interruption* makes us a little reluctant to use it routinely. We had been using it in all cases—but again were forced to the conclusion that in no instance had it saved a limb from amputation—nor had it improved the level necessary for amputation. This coincides with the experiences of Major J. M. Parker on the French front. In the case above mentioned, an extensive soft tissue wound of the left thigh with complete division of the *deep femoral vessels* and their branches produced a cold, blotchy, anesthetic foot. The patient was almost exsanguinated but after 2500 cc. of whole blood his blood pressure was restored from 50/? to 104/60. The foot, however, remained cold, blotchy and without feeling. Our neurosurgeon, well versed in lumbar sympathetic block, injected the lumbar sympathetics in the usual manner with novocaine—followed immediately by a general collapse with drop in blood pressure to 68/?. The thigh itself felt warmer (subjectively) and sweating of the involved limb was inhibited, but there was no improvement in the appearance of the foot. It occurred to us that such an untoward result (lowered blood pressure) might conceivably lead to thrombosis of small important collateral vessels—and therefore be harmful rather

than helpful. The collapse was short-lived, fortunately, and after 1500 cc. more blood, the posterior tibial pulse could again be felt, the foot lost its pre-gangrenous appearance, and the patient recovered without amputation. It is interesting that 4000 cc. of blood was necessary to restore his circulation to normal—an observation repeatedly made in the field. Many of the early deaths on the battlefield and at the field hospital are due to exsanguination and only whole blood will prevent death—not only of the individual but of a limb deprived of. its main blood supply. *Restoration of blood volume is absolutely essential in the presence of an ischemic limb if it is to be saved.*

"Since Nov. 21, 1944, the Navy has been flying universal type "o" blood from San Francisco whence it is distributed in almost unlimited quantities to any outfit in the Pacific Area. Up to about ten days ago 86,000 pints of blood had been delivered in this area! And I am sure we are now saving some lives and limbs that were formerly lost. The blood is shipped in specially iced containers—kept at 40°F.

and is good for twenty-one to twenty-five days. Blood in the next war will be as plentiful as plasma in this war!

"But God willing—there won't be any next war! It is impossible to conceive, but exhilarating to think about, what 100 years of peace could do to wipe out poverty, illiteracy—and the diseases due to deprivation and ignorance. The awful waste of war must be seen to be appreciated: the sacrifice of handsome, able youths in their prime -and it's always the best that die; the mangling of perfect bodies, the ill usage and mal-usage of talent and ability, the horrible destructiveness of war's machines, the terrible waste of Nature's resources (man's priceless heritage) for purposes of destruction rather than construction, the waste of vast projects abandoned after huge expense of time, effort, and money not to mention the incalculable demoralizing effect of the savagery and the boredom of war

on all ranks and all services. There are brief—very brief moments of great heroic courage and great selfless service, but most aspects of war are sordid, and savage, and horrid, smeared with blood and dirt and filth!

"And the end out here is far from sight—as Iwo Jima well illustrates:—the going gets tougher and rougher as we approach Japan. But progress is being made—and ultimate victory is inevitable! Five months ago we were the front—now the front has moved forward 1000 and 2000 miles in this vast expanse of the Pacific! And I wish I were at Iwo Jima taking care of the Marines who are falling there as they fall here."

COMMENTARY BY DR. RUDOLPH MATAS

One fact appears to rise out of Dr. Holman's experience, namely, that a temporary lumbar sympathetic block by novocainization alone, appears to give no certain protection against gangrene of the leg in destructive popliteal injuries in which the collateral branches as well as the main artery are damaged. The greatest hope lies in the restoration of the volume and tension of the arterial supply through any collaterals that may have escaped the catastrophe. In the meantime, all methods and technics that aim at the restoration of the circulation directly through its main channels should be encouraged and cultivated so that a proper appraisement of their actual clinical value in the emergencies of warfare should be definitely determined. Some success was obtained by the French in the first world war by the use of Tuffier's vaselined silver tubes and remarkable success was claimed by the Germans for end-to-end arteriorrhaphy with the Carrel suture and by bridging over arterial gaps with autogenous venous grafts (Carrel, Guthrie, Lexer, Payr); and now the opportunity has come for testing the most promising American contribution to vascular anastomosis, namely, the simplified sutureless venous-lined vitallium tubes of Blakemore and associates, which

exhibit the simplest and, *experimentally,* most successful device for the accomplishment of this long wished for end.

Addendum. November 26, 1945: Dr. Holman's letters were written in January and February, 1944. Since that time, the Blake-more tubes have been sent to several battle fronts, but the opportunities for their favorable application appear to have been relatively few; at least, reports of their actual applications in the field, are not sufficiently available to this writer to permit of definite conclusions.

RUDOLPH MATAS, M.D.

TUNNEL wounds in the neighbourhood of large arteries are the commonest cause of traumatic aneurysm. Swollen thighs, the result of haemorrhage, if kept at rest and watched carefully, slowly resume their normal size, providing there is a good circulation in the foot. When the swelling and bruising subside a pulsating mass with a bruit over it is apparent.

From "Surgery of Modern Warfare" edited by Hamilton Bailey (The Williams and Wilkins Company).

Editorial

HEMORRHAGE IS THE MOST IMPORTANT CAUSE OF MATERNAL DEATH

THE United States Department of State has recently appointed a committee whose objective is uniformity in methods of selection of the principal cause of death when two or more are mentioned. This committee will have the authority of the Joint Committee of the International Statistical Institute and the Health Organization of the League of Nations.

The accuracy of the vital statistics upon which preventive medicine programs depend rests upon certificates of death, on many of which basic data are scanty while on others joint causes are mentioned.

Short of the end of the war, there is no doubt that the subject of maternal mortality touches a more sympathetic chord than any other. Fortunately there is no need to dramatize the *situation*. Maternal death rates have declined so sharply that in many areas attack on new low rates will require a new technic to be successful.

In 1918, largely because of the rise in the crude death rate associated with the influenza epidemic, the maternal death rate in the United States was 9.2 per 1,000 live births, our peak figure. After a similar but lesser epidemic in 1920 with another rise over the previous year, the rate declined, yet very slowly, until 1928

when another rise occurred, apparently as a result of the inclusion of new states in the expanding birth registration area.

Great progress has been made in recent years, with a more rapid rate of decline since 1932 and sharp fall since 1937. In 1943, the latest figures available, the maternal mortality rate was 2.5 per 1,000 live births, the lowest yet recorded. This rate is the more remarkable in view of the rapid expansion of the war program with its corollaries of shifting populations, housing shortages, new sanitary problems, strain of hospital facilities and the highest number of births yet recorded in this country.

The Bureau of the Census, in the last report on deaths from puerperal causes, states that hemorrhage is the third highest ranking cause of maternal deaths, accounting for 1,126 or 15.6 per cent of all maternal deaths. On the face of their statistics, however, 1,991 deaths, or 27.8 per cent, may be assigned to hemorrhage, trauma or shock. And as a matter of fact, according to official figures, hemorrhage has been the second cause of maternal death since 1941.

We are told that septicemia remains the most important cause of maternal death. Rules for uniform treatment of joint causes of death require that infection

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be given precedence over all other causes, so it is the most frequent statistically. Yet only one cause mentioned on the certificate of death is tabulated; the others disappear completely.

The Bureau of the Census is aware of this serious defect in our vital statistics, for in 1941 an official study showed that approximately one-third of the cases in which hemorrhage had been reported on the certificate of death had been assigned by the statistician to other causes. It was found, too, that in a very large number of cases assigned to infection and toxemia, complications and accidents of labor had been reported as well. Since these accidents included lacerations, atony, inversion and rupture of the uterus, dystocia, prolonged labor, instrumental delivery, version, cesarean section and shock, it is easy to assume that a wide river of blood flows through all the statistics.

In the Borough of Brooklyn, City of New York, official statistics show that reduction in the number of puerperal deaths due to hemorrhage has not kept pace with the gains in the infection and toxemia columns. For the last seven years, annual studies by the Brooklyn Committee on Maternal Welfare indicate that hemorrhage is actually the leading cause of maternal death. Preference over septicemia and toxemia was given to hemor-

rhage when actual case reports indicated that it had been severe, yet shock was not included unless hemorrhage had been reported as well.

The true relation between over-all national statistics and the experience of any particular area may be difficult to establish; yet Brooklyn is a large urban center where, for many years, maternal mortality rates have differed but little from national statistical trends.

Infection is now yielding to pressure. In prevention of mortality due to toxemia, the issue is prompt recognition of grave danger signals; there is no specific therapy. Hemorrhage has always been one of the major causes of obstetric death. Whether it is the highest ranking cause or not cannot be shown by present statistical practice. That it is at present the most important cause of maternal mortality is clear for it should yield to preventive and positive therapy more readily than either of the other two major causes.

The precipitate fall in the maternal mortality rate is probably at an end. Further progress will be slower. The goal of the irreducible minimum is still far off. Perhaps the United States Committee for the Study of Joint Causes of Death, when it studies puerperal causes, will give more preference to hemorrhage.

CHARLES A. GORDON, M.D

Original Articles

VESICOVAGINAL FISTULA

AN IMPROVEMENT IN THE CHAFFIN METHOD OF POSTOPERATIVE TREATMENT, USING CHAFFIN SUCTION DRAINAGE

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VESICOVAGINAL fistula is seen much less frequently than two or three decades ago, but even with the decreased frequency due to more skillful delivery in obstetrics, more skillful pelvic surgery and less total hysterectomies, it is still encountered sufficiently often to justify a continued interest. After all, one woman is just as distressed as each of the many were in former years.

This surgical entity does not seem to belong to any one surgical specialty; therefore, I believe any discussion of the subject should be directed to the surgical group as a whole.

It has always been my teaching policy to pass on to my graduate and post-graduate classes something that will enable them to do a better surgical job, rather than to impress on them how good I (as a specialist, which I am not) am. There are probably more fistulas seen and operated upon outside of large surgical centers and clinics than inside; therefore, we, as teachers and writers, should and do have a degree of responsibility of how our pupils (post-graduate classes) do the job when returning to their own operating rooms.

Some schools place vesicovaginal fistulas in the obstetrical service and others the urological department. At the Los Angeles County Hospital where I had a gynecological service, these patients "went begging" as no group seemed much interested, and possibly it was because surgical results were so unsatisfactory previous to fifteen or twenty years ago that neither the hospital nor the surgeon was anxious to accept the responsibility of results or long hospitalization for repeated attempts at repair.

I had given this condition considerable thought for a number of years, and had had considerable experience in males in the matter of suprapubic cystotomies and prostatectomies, and had evolved a theory from that experience. I noted that those suprapubic fistulas always closed quickly and spontaneously (that the normal opening must be adequate is a surgical and physiological axiom) because the fistulous opening was "on top" of the pool, and dry, so to speak. With this theory in mind, I requested the transfer of some of these patients with vesicovaginal fistulas to my service and drew up plans for a surgical approach, combining in these plans the male bladder experience with many years of vaginal plastic surgery. (Figs. 9 and 10.) The technic which I shall describe was carried out to make a good surgical closure of the hiatus and the patient was then placed in a new position not heretofore described (medical library literature searched for a period of fifty years and no mention has been found).

My inborn understanding of mechanics helped me to obtain the maximum degree of gravity draining of urine from the bladder and keep the incision and repair dry. Gravity was the only drainage available to the surgical profession at that time,

so we had to build our problem around gravity.
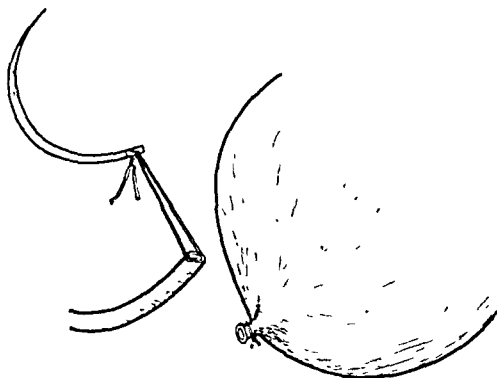
I have since solved the problem of all

FIG. 1. Distal "stump" of ureter ligated at bladder wall; mobilized ureter with "traction" suture of linen, both ends threaded in needle.

surgical drainage by suction,[2,3,4] much better than gravity ever did and I will explain that principle in the present discussion.

In the illustrations (Figs. 7, 8 and 9) from my original article[1] I placed the patient on the abdomen (prone) and on a

seventeen days and one operation. This seemed to be a marked improvement in results over those reported in the literature and I thought I was justified in reporting it. Since that time the technic seems to have been almost universally adopted. Some of those reporting are Counseller[5,6,7] wherein he states, "The use of the Bradford frame is a distinct advance in treatment of vesicovaginal fistulae." I do, however, disagree with him in the mention of nephrectomy if the ureter is involved in bladder fistula. The ureter should be transplanted and the kidney preserved; the fistula is repaired at another time. The Chaffin technique (Figs. 1, 2, 3, 4, 5 and 6) is too simple to justify the sacrifice of a kidney. The results in follow-up of about fifteen of these transplants or implants, justifies this statement. Counseller[7] in another discussion, emphasizes the importance of especially trained nurses to watch the "plumbing" (drainage) because one accidental filling of the bladder may "undo" a good operation.
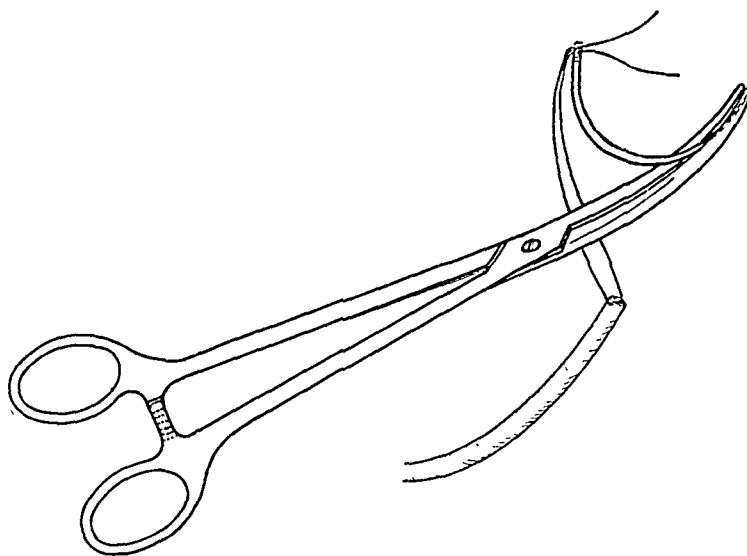

FIG. 2. Needle grasped in "Curved Carmault" covering point.

Bradford frame. Study of the graphic drawings (Figs. 7 and 8) will show the principle of physics and fluids applied to accomplish the results. I operated on seventeen patients with vesicovaginal fistula, ranging from ½ cm. to 7 cm., and all healed well and dry in a maximum of

O'Connor[8] made a hole in the mattress to accomplish the dependent drainage, a suggestion I made in my original article but of questionable economy for the hospital. Tussig[9] emphasizes the prone position. Phaneuf[10] recommends the prone position also. Cattell[11] advised prone posi-

tion but omits the Bradford frame. He reports a recurrence and it may have been due to inadequate drainage as illustrated in Figures 7 and 8.

catheter may be placed to identify the ureter while operating. If the ureter is marginal, a transplantation will be necessary, and the fistula operated upon
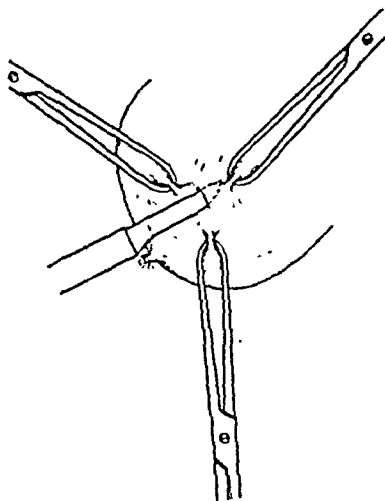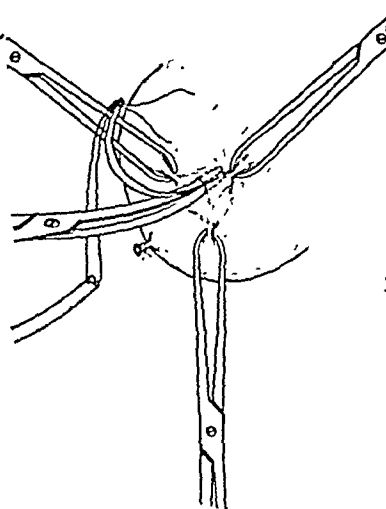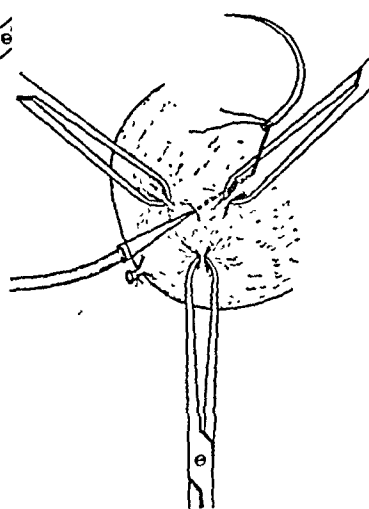

FIG. 3.   FIG. 4.   FIG. 5.

FIG. 3. Showing stab wound in bladder made with narrow knife blade.
FIG. 4. Curved forcep covering point of needle and inserting through stab wound.
FIG. 5. Needle emerges at a distance of 1 inch or more, ready to draw ureter snugly through stab wound.

Bladder fistulas may occur in almost any area of the bladder but the great majority find their way into the vagina because water runs downhill, a phenomenon that I have been accentuating for years, but which is still not recognized by many surgeons, as those who use a Penrose wick in an abdominal cavity and call it a drain.[2,3,4]

The usual location of the fistula is about the trigone and fortunately does not involve a ureter. It is this area that is the most accessible and the one that this paper deals with principally. Bladder fistulas, while emptying into the vagina, may be above the trigone and may be well up on the posterior wall of the bladder. These may require an approach from above, (not transvesical) but no unusual difficulty is encountered. If they are on the posterior wall, the patient requires the same postoperative treatment.

Ureters should always be identified, and their relation to the fistula determined. Also one should positively differentiate between a ureterovaginal and a vesicovaginal fistula. An indwelling uretral

later. The transfer of a ureter per abdomen to a new location in the bladder or the implantation of a severed ureter is an extremely simple matter when there is
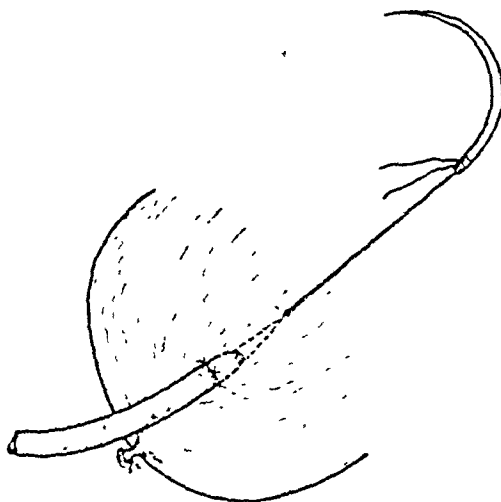

FIG. 6. Ureter held well into bladder while anchoring with three or four interrupted linen sutures.

ample length and there always is in the transplant cases. This technic is described in my previous article.[1] I have used it for twenty-five years, not only in bladder implantation, but to transplant ureters

to the sigmoid as well. I have sometimes called it the "10 minute technic," as that is about as long as it takes after the

for this is not a drain and predisposes to leakage, suture failure and chemical peritonitis. Chaffin suction drainage, using a
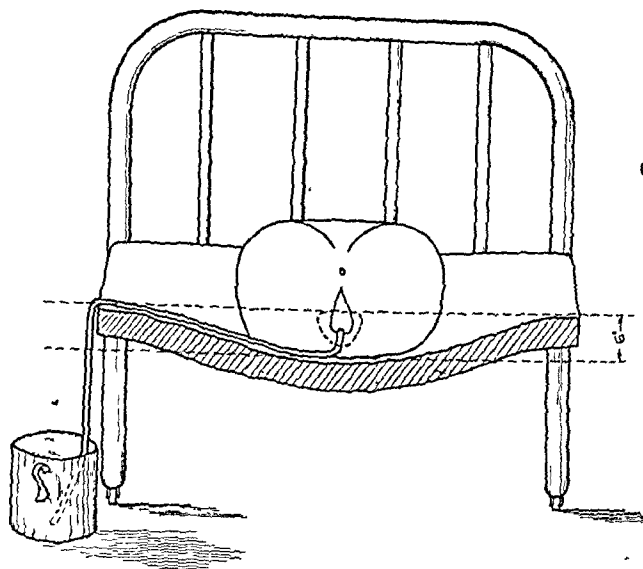

FIG. 7. Cross-section of patient in average bed face down, showing mattress "sag" and bladder full before drainage will start.
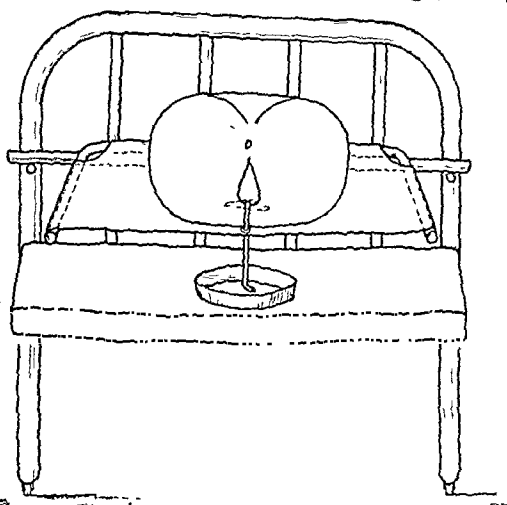
FIG. 8. Cross-section of Bradford frame with catheter passing directly down. Bladder is completely empty at all times.

ureter is mobilized. (Figs. 1, 2, 3, 4, 5, and 6.)

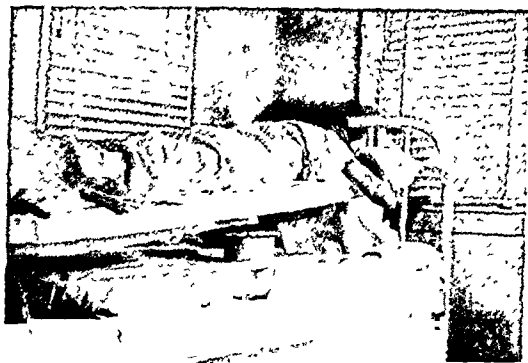A good exposure (essential in all surgery) is obtained by the Trendelenburg (45

FIG. 9. Photograph shows patient on Bradford frame with catheter dropping down into pan for a completely empty bladder as illustrated graphically in Figures 7 and 8. Bradford frame is no longer necessary. The patient is placed on face in bed and Pratt suction pump and "T" tube arrangement produces better drainage and greater comfort.

degree) position. (Many surgeons call a 10 to 15 degree table tilt a Trendelenburg position.) Uretral transplants of any sort should be protected with Chaffin suction drainage.[2,3,4] Do not use a wick in a vent

Chaffin tube and Pratt pump insures against all of these.

Operative Procedure. After determining that the ureter is well away from the fistula (.5 to 1 cm.) the patient is placed on the abdomen as shown in Figures 10 and 11, prepared with Cook County Hospital prep solution, and the Mayo instrument table placed against the thighs. (Fig. 10.) This places all instruments directly under the surgeons right hand, thereby eliminating unnecessary reaching and many purposeless movements.

STEP-BY-STEP TECHNIC

1. Two Gilpi retractors are used, one *to separate buttocks at anal level and* the other to spread vagina.

2. Cover retractor with towels to avoid suture tangles.

3. Sim's retractor in perineum, pulled up by a strong assistant. (Usually necessary to incise perineum to the sphincter ani to get good exposure.)

4. Pull down cervix (if cervix is absent the scar above the fistula is seized in the tenaculum). This places the surgical site directly in front of the operator with good

exposure and an opportunity to work on a flat surface. (Figs. 10 and 11.) Lateral retractors aid in exposure.

9. Place a small rubber catheter (plain not Pessar) into the bladder about 2 inches and secure with cotton cord and adhesive.
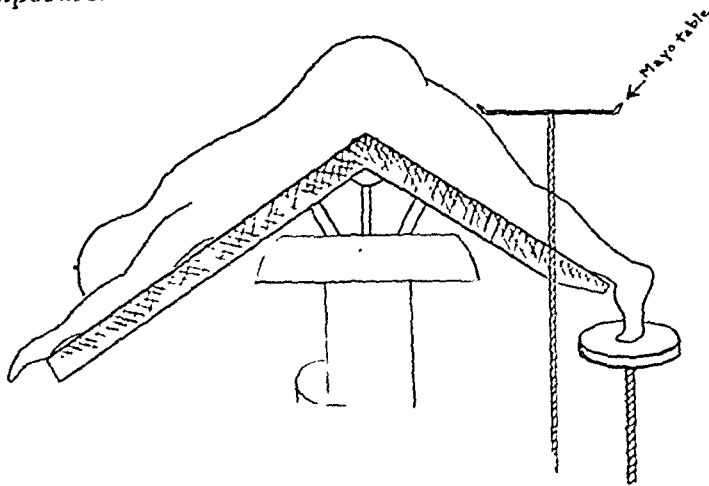

FIG. 10. Position of patient with Mayo table making instruments convenient. Two Gilpi retractors (not shown) are used to spread buttocks and vagina.

5. Vertical incision is made over fistula, 1 cm. above and below, through vaginal wall (use small tonsil sponges and long tissue forceps for sponging).

6. Carry dissection back 1 cm. in all directions and hold vaginal flaps with long Allis or sutures.

10. Cut off the catheter about its middle or fairly close to the perineum, attach by "T" glass connection to a $\frac{3}{16}$ inch pure gum tubing, sufficiently long to reach over the bed (3 to 4 feet). Attach small rubber tube to side arm of "T" tube and bring up and strap to buttocks
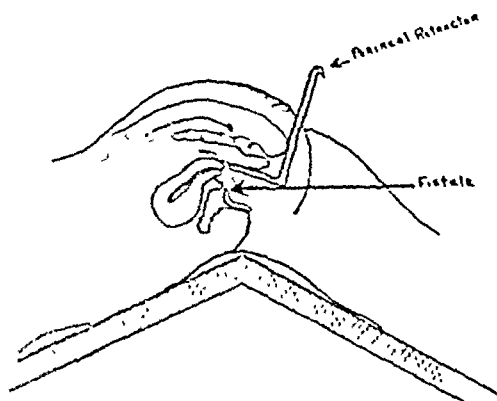

Fig. 11.

Fig. 12.

Fig. 11. Site of fistula is shown with exposure to make operation site accessible. (Gilpi not shown.)
Fig. 12. Mattress "sag" of no importance, as urine is "sucked" up rapidly (Pratt pump, 1 quart per minute) at a low pressure of 20 inches water or 3 inches on standard, 30 inch vacuum guage). "T" Tube is necessary to admit air; therefore, there is no suction on the bladder.
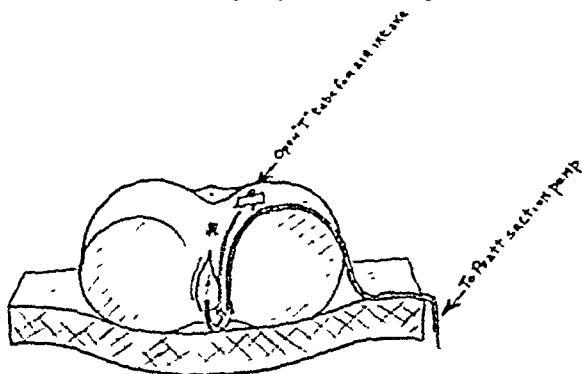
7. Suture the bladder opening with gastrointestinal chromic catgut and curved needle, interrupted.

8. Close vaginal wall with any suture of your choice: gut, silk, linen, cotton or wire.

with adhesive. This remains open for suction air intake.

11. Place the patient in her bed, not Bradford frame, in the prone position. *This is the point where we remove the patient from the Bradford frame where she has been*

for ten or fifteen years and make her more comfortable.

This completes the operation and it is

be "wet" and possibly under pressure. It is important to have no urine in contact with the water and chemicals and possibly
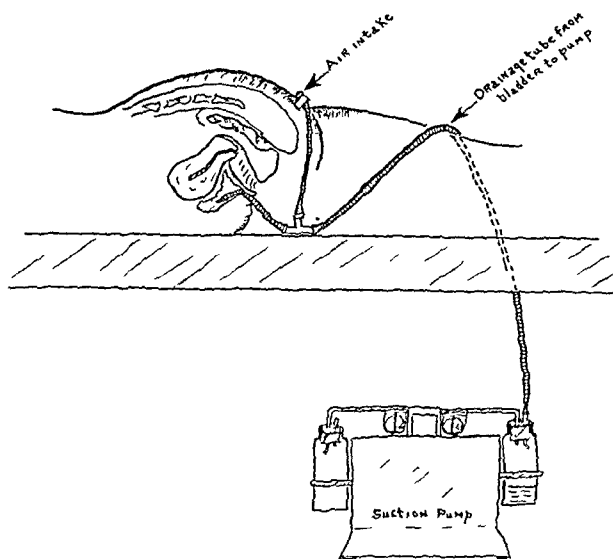
FIG. 13. Catheter in place with tube over thigh to prevent kinking; "T" tube to admit air. Suction should not stop during entire postoperative treatment (about ten days).
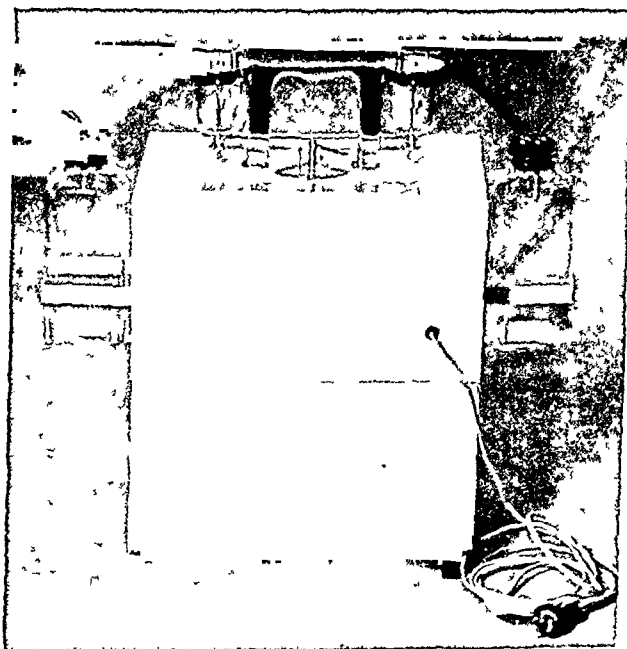
FIG. 14 Photograph of Pratt pump, silent in operation and runs continually; controlled suction for all surgical fields; two collection bottles

from this point that the Chaffin suction technic applies. Referring to the drawings (Figs. 7, 8 and 9) you will note that if the patient was placed in bed (Fig. 7), the bladder would fill and the suture site would

infection washes out the fibrin (first essential for primary healing). Too much emphasis cannot be placed on this point as we have abundance of evidence in other fields, as in suprapubic prostatectomy,

gallbladder drainage and others. I have often asked the surgeon why he directed a quantity of bile into his incision, or the urologist why he permits the bladder to fill up and extravasate into the incision and the only answer was, "How else should I do it?" I have given the surgical profession a method of suction whereby this can all be avoided.[2,3,4]

The long, large catheter extension tube with the "T" tube making a vent for air intake, goes to the Pratt bedside pump which maintains a constant day and night suction of 20 inches of water and is continued for ten days to two weeks. (Figs. 12 and 13.) The patient may have her bowel movements in this position at which time we place a small pleget of moist antiseptic cotton in the vagina or she may be turned on her back for this short time.

The explanation of the suction and bed position is this (Figs. 12 and 13): The urine flows out of the bladder to the bed level by gravity. The suction pump picks it up at this point and lifts it over the edge of the bed, or even over the thigh more effectively than the Bradford frame and gravity method, with much greater comfort. Emphatic caution: *Do not try to apply suction to a closed catheter as it will not empty the bladder any more than a bottle can be emptied without admitting air. The mucous membrane will be sucked into the eyelets and stop the flow.*

The Levine Tube in the stomach is entirely different and cannot be used as a counter argument. Air enters the stomach from swallowing and from the intestines, therefore, not a closed cavity.

Many of these fistulas will close without surgery if the patient is placed in bed with suction drainage and the opening cauterized, or curretted. We have had several.

SUMMARY

Results of surgical treatment of bladder fistulas were unsatisfactory until about

the time of the publishing of my original article advocating the prone position of the Bradford frame for complete drainage. Review of the literature since that time indicates that surgical results are more universally satisfactory. The position of the patient caused some discomfort and complaint due to the rigidity of the Bradford frame. We have removed the woman from the frame and placed her in bed with *still better drainage.* We have illustrated operative positions of the patient for good exposure and an easy operation.

CONCLUSIONS

Suction drainage is applicable to scores of surgical fields and especially fits this pathological entity. Suction drainage lowers mortality in all abdominal surgery, possibly as much as 80 per cent and in ureter and bladder fistulas and transplants, is adequate insurance against failures or complications. Suction drainage, now used in scores of hospitals and clinics, will be used by all progressive surgeons in all hospitals in the near future.

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EFFECT OF PARENTERAL SALINE SOLUTION ON WOUND HEALING

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THE healing of laparotomy wounds is of great importance to every surgeon. However, it is such a basic consideration that surgeons are not apt to give it any special thought unless confronted by wound disruption or the appearance of a postoperative hernia. Most surgeons expect to have a certain number of postoperative hernias in a large series of abdominal operations, but wound disruption, with or without evisceration, is such a serious complication that every possible precaution to avoid it should be kept in mind.

There are several factors that may affect the healing of wounds. It is well recognized that the patient's general health plays an important part in the process of healing. In persons who are poorly nourished, those with hypoproteinemia, with jaundice, and with certain systemic diseases there may be a disturbance in wound healing. This type of patient deserves, and usually gets, special consideration in preoperative and postoperative care, in order to restore to as near normal as possible his rate of healing. Attention to such special problems is admittedly important. Attention to many small details in the handling of laparotomy wounds of all patients, regardless of their general health, is also important. The type of incision, the care and gentleness in handling tissue, strict attention to asepsis and hemostasis, the choice of type and size of suture material, and the care in approximation of wounds without strangulation of tissue all will influence the rate and security of healing of an incision. Many of these small details may be ignored, and satisfactory wound healing obtained in almost every case. However, by constantly striving to perfect surgical technic the surgeon will invariably secure better end results.

It is the purpose of this communication to call attention to parenteral saline solution as a factor which may influence the security of healing of laparotomy wounds. In reviewing the cases of wound disruption in our hospital, one thing seemed outstanding. Almost every case occurred in patients who had received large amounts of parenteral saline solutions, several getting over 100 Gm. of sodium chloride within a week. It is generally recognized that intravenous fluids are given rather haphazardly, and glucose in saline solutions seems to be more popular than glucose in distilled water. It seems reasonable to assume that excessive saline solution in the body tissues might do real harm to the process of repair in a wound. We know of the difficulty of healing a wound in an edematous ankle or leg. It is not uncommon to see a patient receive enough saline solution to cause grossly visible edema, and lesser amounts may reasonably cause "sub-clinical" edema.

In postoperative patients, it can be shown that intravenous or subcutaneous saline administration neither causes elevation of blood chlorides (Table I) nor does it increase the urinary excretion of chlorides. In fact, the postoperative excretion of chlorides in the urine is considerably diminished for a number of days. (Table II.) The administered saline must, then, be distributed throughout the body tissues, and by osmosis, an increased amount of fluid will collect in the tissues. Chlorides collect readily in areas of inflammation, whether the inflammation is due to bac-

terial injury or to trauma from an incision. Therefore, it would seem reasonable to assume that a surgical incision collects a relatively large proportion of the administered saline solution, thus increasing

the effect of parenteral saline solution on the rate of healing of abdominal incisions, the following methods were used: Adult white rabbits were separated into three groups. Under general anesthesia the

TABLE I
BLOOD CHLORIDE DETERMINATION

	A	B	C	D	E	F
Preoperative level	480 mg. %	465 mg. %	475 mg. % 1000 cc. glu-cose in saline	460 mg. %	475 mg. %	470 mg. % 1000 cc. glu-cose in saline
Postoperative level	450 2000 cc. glu-cose in water	450 3000 cc. glu-cose in water	480 3000 cc. glu-cose in saline	450 3000 cc. glu-cose in saline	460 1500 cc. glu-cose in saline	480 3000 cc. glu-cose in saline
Level at end of first 24 hours	460 1000 cc. glu-cose in water	475 1000 cc. glu-cose in water	450 1000 cc. glu-cose in saline	400	410 2000 cc. glu-cose in saline	460
Level at end of second 24 hours	530	470 1000 cc. glu-cose in water	480	490	475	530
Level at end of third 24 hours	520	480	475	440	455	515

Columns A and B illustrate the trend of blood chloride levels in patients that receive glucose in distilled water postoperatively.

Columns C, D, E, and F illustrate the trend of levels in patients receiving glucose in saline. Note how chloride levels tend to become lower soon after administration of large amounts of saline, as if additional chloride had been "washed out" of the blood.

TABLE II
EXCRETION OF CHLORIDES IN THE URINE

Preoperative excretion	11.11 Gm. 2000 cc. glu-cose in water	8.20 Gm. 3000 cc. glu-cose in water	12.04 Gm. 4000 cc. glu-cose in saline	10.26 Gm. 3000 cc. glu-cose in saline	9.30 Gm. 1500 cc. glu-cose in saline	12.40 Gm. 1000 cc. glu-cose in saline
Postoperative excretion first 24 hours	3.42 Gm. 1000 cc. glu-cose in water	5.2 Gm. 1000 cc. glu-cose in water	8.04 Gm. 1000 cc. glu-cose in saline	5.6 Gm.	10.02 Gm. 2000 cc. glu-cose in saline	4.2 Gm. 3000 cc. glu-cose in saline
Excretion during the second 24 hours	4.83	2.63 1000 cc. glu-cose in water	6.12	8.52	1.73	7.02
Excretion during the third 24 hours	2.08	4.80	3.55	1.48	7.23	2.70
Excretion during the fifth 24 hours	3.90	3.96	6.3	1.2	4.8	6.4
Excretion during the seventh 24 hours	0.86	12.30	10.7	7.82	9.67	12.36

This table illustrates tendency of urinary chloride excretion to be diminished during the first postoperative week, regardless of whether the patient is getting glucose in water or glucose in saline solution.

the edema of the wound tissues. This added edema in the wound would naturally delay healing, make it a weaker wound, and could actually cause strangulation of tissue by the sutures.

Experiments. In order to investigate

abdomens were carefully shaved and prepared with ether and alcohol. Vertical incisions, 5 cm. long, were made just to the right of the midline. The incisions were made as nearly identical as possible and sutured in identical manners. Chromic

No. ooooo was used in part of the animals, chromic No. ooo in part, and plain No. ooo in part of them. One group was given 22 cc. of glucose in saline solution per pound of body weight per twenty-four hours. Another group was given the same amount of glucose in distilled water. The fluids were administered partly by vein and partly subcutaneously, and the animals were allowed nothing by mouth. The third group was given a regular diet by mouth without any parenteral fluids. The animals were sacrificed on the seventh post-

enough to cause separation of the wounds. The highest reading on the mercury manometer obtained before wound disruption occurred was recorded as the wound disruption pressure. (Table III.) The average pressure which was necessary to disrupt those animals that had received glucose in saline solution was 67 mm. of mercury, while those animals receiving glucose in water were able to withstand an average intra-abdominal pressure of 101 mm. of mercury before wound disruption occurred. The results in this group of

TABLE III
DISRUPTION PRESSURE OF LAPAROTOMY WOUNDS

Animals That Received Glucose in Saline	Animals That Received Glucose in Water	Animals That Received a Regular Diet
Wounds Sutured with No. ooooo Chromic Catgut		
102 mm. Hg.	143 mm. Hg.	131 mm. Hg.
97	120	140
100	140	129
108	110	127
Wounds Sutured with No. ooo Chromic Catgut		
63	102	108
72	114	107
68	98	
78	102	
64	98	
58	100	
Wounds Sutured with No. ooo Plain Catgut		
38	48	
42	Infection	
Infection	Infection	
22	54	
27	68	

TABLE IV
TISSUE CHLORIDE DETERMINATIONS

	From Animals Given Regular Diet Postoperatively	From Animals Given Saline Postoperatively	From Animals Given Glucose in Water Postoperatively
Specimen from wound.........	2.83 mg. %	3.23 mg. %	2.80 mg. %
Specimen from abdominal wound.	2.10 mg. %	2.64 mg. %	2.42 mg. %

operative day at which time the strength of their abdominal incision was determined as follows: Under anesthesia a No. 17 gauge needle was inserted into the abdominal cavity and connected to a mercury manometer, air was gradually introduced into the abdomen through a smaller needle in the opposite side until the intra-abdominal pressure became great

animals that received a regular diet postoperatively, originally separated as a control group, did not differ significantly from animals receiving glucose in water, as far as the strength of their wounds was concerned. Therefore, this series was not continued, as it seemed to us that the question was one of choice of fluids when parenteral fluid is necessary, rather than a choice between a diet and parenteral fluids. It will be noted that the wounds of animals receiving glucose in saline solution were, on the average, 32 per cent weaker than the wounds of animals receiving glucose in water.

From a number of the animals, sections of tissue from the wounds and samples from other areas of the abdominal wall were taken for tissue chloride analysis. Examples are given in Table IV. It can be seen that wound tissue is richer in chlorides than is normal tissue, and the wound

tissues and normal tissues of animals receiving glucose in saline solution have a higher chloride content than do those receiving glucose in water. Also, the difference between wound tissue and normal tissue chlorides is greater in those animals receiving glucose in saline solution.

Comment. The usual so-called "isotonic saline" solutions contain 8.5 or 9 Gm. of sodium chloride per liter. A person certainly does not require this much salt each day for normal metabolic processes. A healthy, ambulatory person can excrete excess chlorides through the kidneys. Postoperatively, however, the patient's kidneys do not seem able to excrete an excess amount of sodium chloride, such as he would get if given a liter of "isotonic saline" solution. It would seem that most patients receive parenteral saline solutions when they do not require it and cannot handle it. Therefore, it may, if given in sufficient amounts, collect in the tissues and so weaken the laparotomy wound, or delay its healing, that disruption may occur. Saline solution given postoperatively may cause disruption of the wound by acting in two different ways: Not only by delaying the healing of the wound, but it may also be a cause of distention of the intestines, thereby increasing tension on the wound.

Obviously, if a patient is losing chlorides through gastric suction, fecal fistula, or a diarrhea, he should receive saline solution as replacement. It is probable that one or two liters of saline solution given postoperatively as a routine will do no significant harm; but we believe that in those cases that require parenteral fluid therapy for a period of several days, saline solution should be used cautiously and only as replacement for that lost by the patient. Fluid therapy can be carried on in the form of glucose in distilled water for weeks without significant alteration in blood chloride levels provided the patient is not losing chlorides by one of the routes mentioned above. It is strongly urged that fluids in the postoperative period be primarily glucose in water and not glucose in saline solution.

SUMMARY

Parenteral saline solution given to postoperative patients is distributed principally throughout body tissues with a relatively larger proportion going to the wound tissues.

In experimental animals, the administration of saline solutions for five postoperative days causes a delay in the healing of the laparotomy wound.

It is suggested that the administration of saline solutions be limited to patients who have definite requirements for it, and not routinely as practiced by many surgeons.

The injudicious use of parenteral saline solution may, in certain cases, be responsible for wound disruption.

EARLY AMBULATION FOLLOWING SURGERY

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THE practice of early postoperative walking following operations done within the abdomen or pelvis appears to have much to commend it and in many centers has become a standard procedure in the postoperative care of surgical patients. Because the results have been so generally favorable, we wish to discuss briefly the subject and present our experiences with it.

Early ambulation following surgery was first suggested by Ries[1] in 1899 who employed it in several cases with apparently no untoward effects. The practice never became very popular in this country, however, until comparatively recently when the work of Newburger,[2] Leithauser and Bergo,[3] Ochsner and Debakey,[4] Nelson and Collins[5] and others demonstrated conclusively that early activity following surgery was not only devoid of danger, but actually possessed advantages that led to a smoother postoperative convalescence and an earlier rehabilitation of the patient.

Recently acquired knowledge in the fields of surgery and surgical physiology have supplied us with improved technics, a better understanding of the fundamentals of wound healing, improved suture materials, and vitamin and protein preparations of standard potency to insure the optimum in wound repair. These factors offer a sound basic foundation upon which an understanding of the advantages of early postoperative activity may be predicated. This basic knowledge, together with two fundamental yet diversified observations, has done much to stimulate the institution of a program designed to avoid the time-honored procedure of enforcing rest in bed for periods ranging between ten days and two weeks following operations on the abdomen and pelvis and repair of hernias.

The first of these observations concerns the excellence of wound healing and the notable absence of serious postoperative complications in children despite the practical impossibility of preventing them from being active and ambulant beginning almost immediately following their recovery from the anesthetic, and the knowledge of a similar phenomenon occurring following abdominal section on animals used for experimental purposes. The second observation centers about the circumstance that serious postoperative complications in the aged, especially those referrable to the pulmonary and vascular systems are largely prevented if confinement to bed for long periods of time can be avoided. Armed with these observations and assuming that if early ambulation lacked serious ill-effects and presented certain advantages for patients in these two categories, it should likewise possess similar advantages for the great mass of surgical patients falling between these two extremes of life. It has recently been extensively employed in the hopes that it might prove to be a factor in reducing the incidence of certain postoperative complications that often present a discouraging problem in the field of surgery.

POSTOPERATIVE COMPLICATIONS

It is an accepted fact that frequently surgical patients who have had the benefit of adequate preoperative care and preparation and in whom a technically correct and carefully executed surgical procedure has been accomplished, will often develop certain postoperative complications in which local reaction following abdominal incision and removal of a local lesion does not

appear to be an important factor. These complications are sufficiently serious occasionally to eventuate in a fatal issue, and often at least, increase the suffering and prolong the convalescence of the patient. Notable among these complications are atelectasis, hypostatic pneumonia, intestinal distention and ileus, passive congestion, and venous thrombosis with embolism and infarction.

It can be confidently stated that all of these conditions may logically be related in their incipiency either directly or indirectly to bed rest in the dorsal recumbent position for varying periods of time irrespective of the cause. That bed rest and inactivity alone is not always the only precipitating factor is admitted for it is known that such conditions as age, depth of anesthesia, amount of narcotics administered, and the disease for which operation was undertaken, are all factors that may potentiate or enhance the inherent possibilities of bed rest in the production of these complications. Nevertheless, sufficient evidence has now accumulated, both clinical and experimental, to justify the assumption that other things being equal, enforced inactivity in bed will do more to promote postoperative complications of this type than any other factor.

We hope to show as the result of our experiences together with the results reported by others that early ambulation not only decreases the incidence of these complications, but in addition possess advantages that make a surgical operation a more pleasant experience for the patient and shortens the period of time elapsing before complete rehabilitation occurs.

APPENDECTOMIES

During the past four years we have employed early ambulation following all appendectomies irrespective of the pathological state of the appendix encountered at operation. Our series (Table 1) includes 150 personal cases varying in age between nine and seventy-eight years. For purposes of comparison we took the records of an

equal number of unselected cases of appendectomy performed by thirty different Duluth surgeons. These cases were believed to be sufficiently similar in the degree of involvement, age and sex ratios, etc., to be adequate for comparative purposes.

TABLE 1
SUMMARY OF APPENDECTOMIES

	Our Series	Control
1. Total No. of cases..................	150	150
2. Average No. of days in bed before becoming ambulant..............	2.3	7.3
a. No. of patients up on 1st postoperative day.................	24	0
b. No. of patients up on 2nd postoperative day.................	70	2
c. No. of patients up on 3rd postoperative day.................	48	0
d. No. of patients up on 4th postoperative day.................	8	148
3. Total No. of days hospitalized following surgery..................	5.5	9.8
4. Average No. of hypos of 1/6 gr. of M.S. per patient..................	3.7	5.9
5. No. of instances of complications....	0	8
6. Average No. of catheterizations per patient.	1.3	2.3

In our series of cases the average number of days of confinement to bed before the patient became ambulant following surgery was 2.3 days, while in the control series the patients were allowed up only after they had spent an average of 7.3 days in bed, or nearly triple our figure. In our series there were twenty-four instances in which the patient was allowed up after remaining in bed for only one day. In seventy cases the patients remained in bed for two days or less, and in forty-eight cases they were ambulant by the third postoperative day, making a total of 142 out of 150 cases in which confinement to bed following surgery was for three days or less.

Comparing this with the control series we find that no patient was allowed up on the first postoperative day, two patients were confined to bed for two days or less, and the remaining 148 patients became

ambulant some time after the fourth postoperative day. On the whole, the majority of these patients remained in bed for the customary period of six to ten days following surgery.

In comparing the total number of days of hospitalization required by each patient following surgery we find a similar striking difference. In our series of cases the average number of days per patient was 5.5, while in the control series it was 9.8 days, or a saving of 4.3 days per patient in our cases. By the simple procedure of multiplication then, we arrive at a total saving of 645 hospital bed days, which is a matter of hospital economy that deserves to be weighed carefully, especially in these days of critical bed shortages.

It is extremely difficult to estimate statistically the degree of such a variable factor as postoperative discomfort, in which the personal equation plays such a dominant rôle. We have been impressed, as the result of our personal observations, with what we felt was a milder postoperative course in which the patient experienced less pain and discomfort when confinement to bed was limited to a relatively short period. However, in comparing the two groups of patients the only factor that we could discover, which we felt would be sufficiently significant to be of practical help in determining this, was the amount of morphine required to maintain a reasonable degree of comfort for the patient. Since most of the patients received hypodermic injections of ⅙ gr. of morphine sulfate at varying intervals, we have employed the total number of injections received during the postoperative period as the criteria of the degree of discomfort imposed by the operation. In our series of cases we found that each patient required an average of 3.7 hypodermic injections during the postoperative period, while in the control cases the average number of injections per patient amounted to 5.9. While we recognize that this may not be entirely accurate, it would seem to reflect less discomfort as manifested

by a decreased requirement for narcotics in those cases in which early postoperative activity was permitted.

In our series of cases there was not a single instance of severe wound infection, wound separation or disruption, abdominal distention, thrombophlebitis, or urinary tract infection. In the control group there was one instance of excessive vomiting associated with abdominal distention, three cases of wound infection, one case of wound disruption, and three cases of cystitis.

Since cystitis is nearly always the result of postoperative catheterizations and since anything that would reduce the number of catheterizations would lessen the incidence of this complication, we have made a comparison of the frequency of catheterizations in the two groups of cases. In our series of cases we found the average number of catheterizations per patient during the postoperative course was 1.3, while in the control group it was nearly double that or 2.3 per patient. We recognize here also that this result may not accurately reflect the true state of affairs because of the extreme variability of bladder control following surgery and the effects on it of certain types of anesthesia, but here again, the trend would seem to indicate and one would logically expect, a decreased necessity for catheterizations in those patients who are allowed to be up and walk to the bathroom at an early period in their postoperative course.

We have employed the McBurney incision or slight modifications of it for all cases in which we felt reasonably certain of the preoperative diagnosis. In the occasional case in which unexpected pathological conditions were encountered demanding a greater degree of exposure we have utilized the Weir extension with complete satisfaction and with no interference to our program of early postoperative activity. We believe, on the basis of our experiences, that the McBurney incision is the incision of choice for the extirpation of acute suppurative, gan-

grenous or perforated appendices, because of the fact that it affords sufficiently adequate exposure, prevents contamina-

patients sit up in a chair for periods varying from fifteen to thirty minutes once or twice a day, and many take a few steps or are
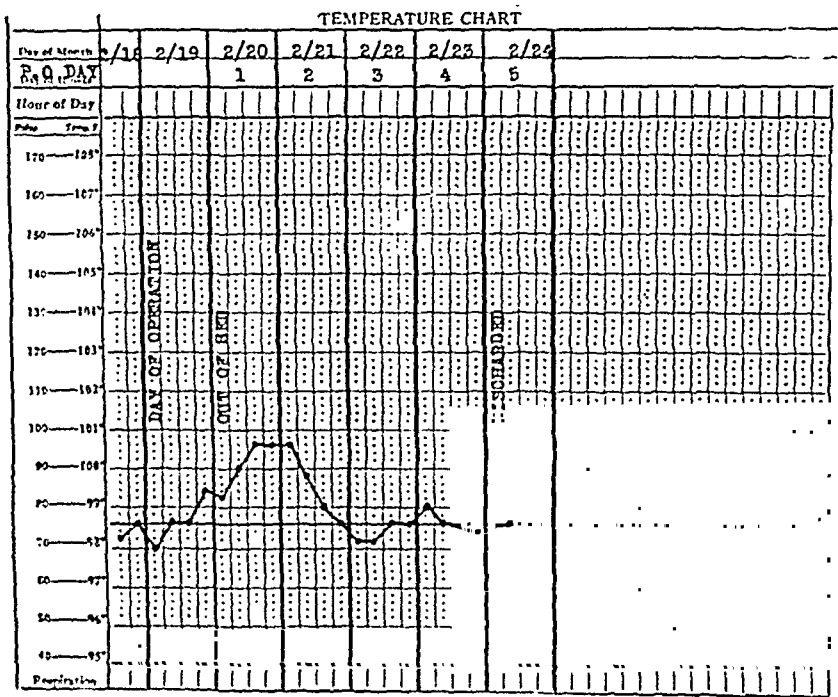

FIG. 1.

tion and soiling of the general peritoneal cavity, and reduces to a minimum the opportunities for the development of wound separations and postoperative hernias. All McBurney incisions have been closed with a running suture of chromic o catgut in the peritoneum, and interrupted sutures of the same in the muscle and fascial planes.

Postoperatively, the patients are given the usual routine care consisting of liquids as tolerated by mouth, frequent deep breaths under supervision, frequent change of position, and narcotics as required to maintain a reasonable degree of comfort. On the whole, all the patients are allowed up on the first postoperative day if they so desire. We have never made it a practice of insisting or flatly ordering the patient out of bed at an early date, but we have found that in practically every instance the suggestion has been readily and almost eagerly accepted by the patient. Usually, by the second postoperative day, these

aided in walking to the bathroom. No restrictions are placed on the patient's activities and the patient is allowed to be the sole judge of the amount of activity he is permitted. By the third day they are up and about under their own power, and they are usually ready to leave the hospital by the fourth or fifth day. The patients are allowed bathroom privileges at any time they desire following operation, and if after a moderate amount of straining no results are forthcoming, enemas are administered. However, it has been our experience that as patients become ambulant earlier their intestinal tract functions more normally and enemas become increasingly unnecessary. The majority of the patients are completely ambulatory by the tenth or twelfth day and come to the office for removal of the skin sutures. Most of them are back to their usual occupation within ten days to two weeks of the date of surgery.

HERNIAS

We were so favorably impressed with the results of early ambulation in our

inguinal hernia. The series also included one large postoperative hernia which was repaired. All of the patients were out of
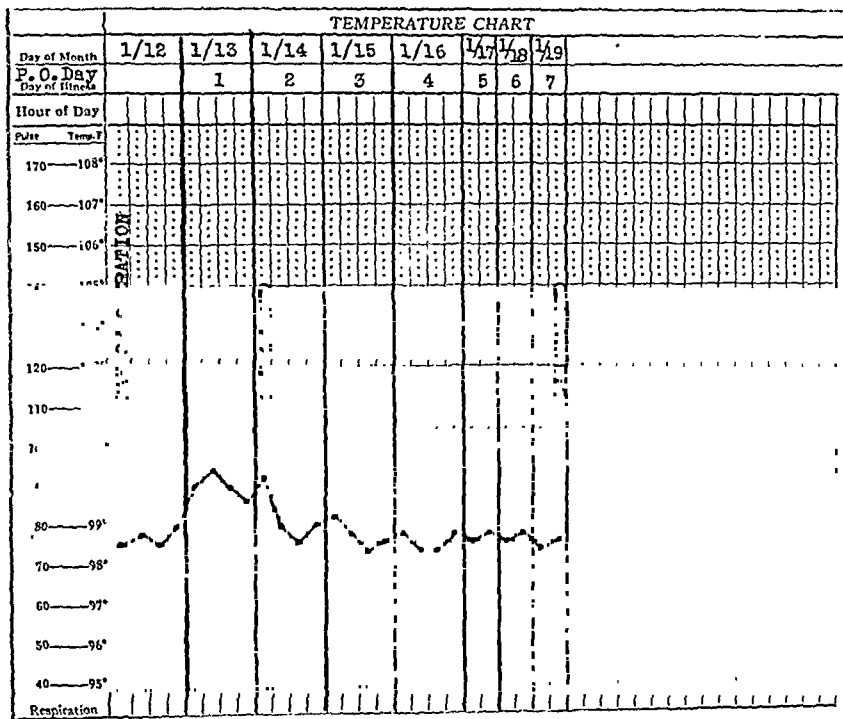

FIG. 2.

appendectomy cases that we broadened our indications to include a small series of hernia repairs and a few additional selected abdominal procedures. Because the series is so small we have made no attempt to make an exhaustive study of them or to compare them with control groups, but we merely wish to present a few pertinent facts to establish a basis for further trial in these types of cases.

In the past six months we have employed postoperative ambulation in fifteen patients with hernias on whom sixteen repairs have been effected. In eight cases the surgical repair of indirect inguinal hernia was carried out, and in one case an indirect hernia was corrected and a first-stage Torek procedure was done for the relief of an associated undescended testicle. There was also one instance of repair of bilateral indirect inguinal hernia. In three cases the repair was for direct inguinal hernias, and there was also one instance of repair of a recurrent direct

bed and ambulant by the third postoperative day, and all except one had left the hospital by the seventh postoperative day. The single case that remained in the hospital longer than seven days was an elderly County case who lived alone and was permitted to remain in the hospital until she was sufficiently well to care for herself upon discharge.

In this small series we have noted no instance of serious postoperative complications, and to date there has been no instance of recurrence of any of the hernias. Furthermore, we have again observed in these cases a milder and more comfortable convalescence and a more rapid return to their former occupation.

SILK TECHNIC

Silk suture material has been employed throughout both in the repair of this group of hernias and in the few selected abdominal procedures that will be presently presented. While many authorities insist

that early ambulation may be safely utilized in abdominal wounds closed with catgut sutures, the weight of evidence is in catgut and the non-absorbable suture in the same wound, are strictly adhered to, draining sinuses will eventuate in a
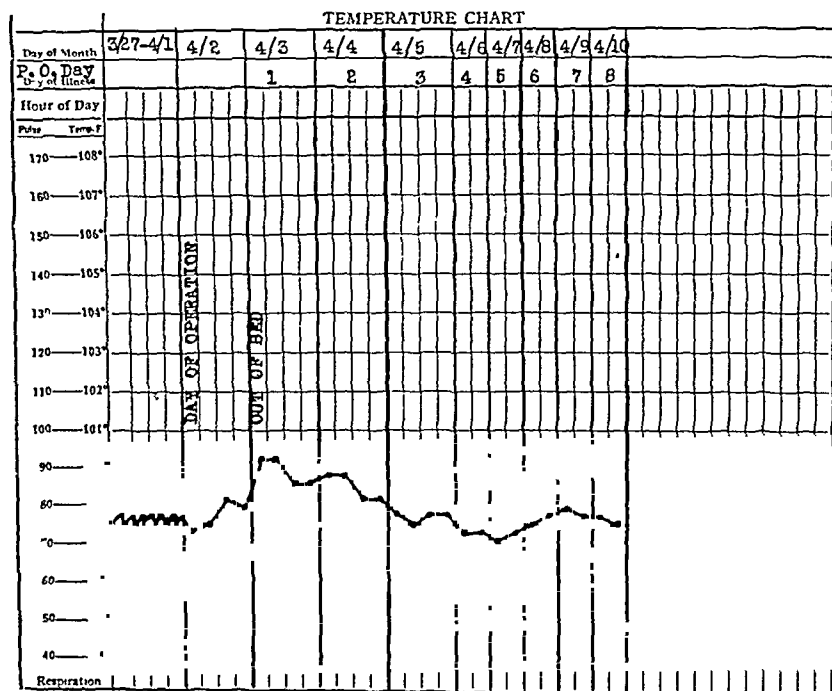

FIG. 3.

favor of conservatism in allowing unrestricted activity except in cases in which non-absorbable suture closure is effected. The type of non-absorbable suture employed is probably not important since the recent work of Localio et al.[6] has demonstrated quite clearly that there is very little difference in the tensile properties and healing activities between the various non-absorbable sutures in common use today. We anticipate possible objections to the suggestion of employment of silk in the closure of abdominal wounds, but we feel justified in asserting that where draining sinuses result from the use of a non-absorbable suture, the fault lies not with the suture material, but with the technic with which it is employed. Unless the principles of strict asepsis, avoidance of mass ligature of tissue, the employment of interrupted sutures only, employment of the finest available sizes of silk commensurate with adequate tensile strength, and the avoidance of mixing

sizeable portion of the wounds in which it is placed. However, with proper care in handling the tissues and strict adherence to the principles of the silk technic a stronger wound and improved healing will occur, and the dangers of disruption and separation will be minimized.

We would like to present a few of the cases in which we have employed silk closure and instituted early postoperative walking and activity. These cases do not include all in whom we have permitted early ambulation, but rather they are presented because they constitute a fairly representative group and because they portray so well the advantages resulting from earlier postoperative walking and activity.

CASE REPORTS

CASE 1. Mrs. J. G. (Fig. 2.) This twenty-four year old white female was admitted to St. Mary's Hospital on February 18, 1945. She was operated upon the following morning through a lower midline incision, and a right salping-

ectomy was done for an ectopic pregnancy that was undergoing a tubal abortion. All vessels were ligated with No. 0000 Deknatel silk and closure of the wound was affected with

a source of considerable satisfaction to walk into the ward on the second postoperative day and find the patient standing before a mirror on the wall combing her hair.
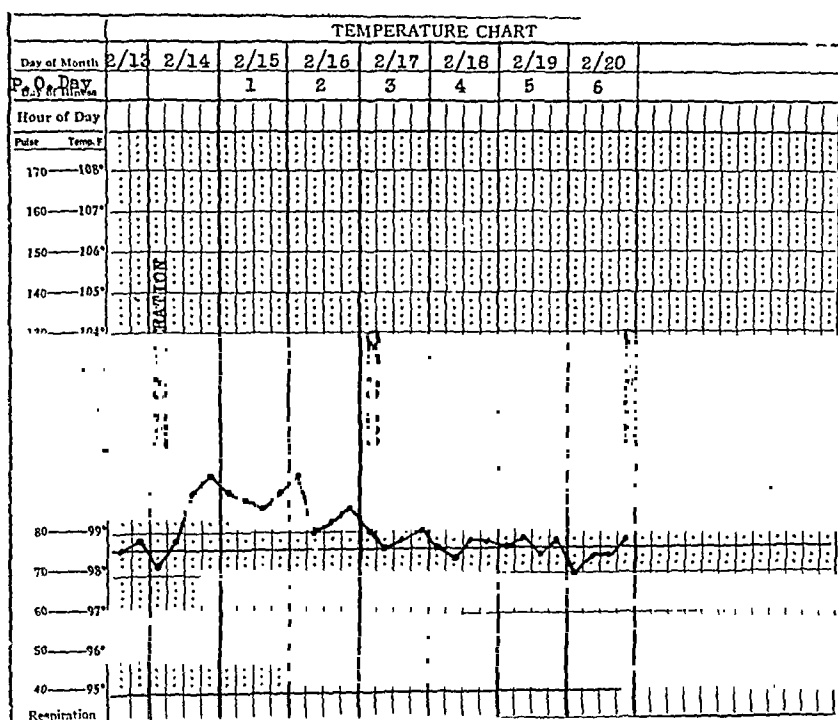

FIG. 4.

a continuous suture of chromic No. 0 catgut in the peritoneum, and interrupted sutures of No. 000 Deknatel silk in the fascia and skin. Her general reaction and postoperative course were mild and uneventful as observed on the accompanying temperature chart. On the first postoperative day she was allowed to stand by the side of the bed for a few moments and then sat in a chair while the nurses changed her bed. This procedure was again repeated later in the day. On her second postoperative day she sat in a chair for a longer period of time and in addition was aided in walking to the bathroom. An enema was administered on the third day after operation following which she walked to the bathroom, unaided, for evacuation. Thereafter she became rapidly completely ambulant and was discharged from the hospital on her fifth postoperative day. Her wound healed by primary intention, and the skin sutures were removed at the office on her tenth postoperative day. The most striking feature of this case was the remarkable absence of postoperative discomfort and the excellent morale manifested by the patient throughout her entire postoperative period. Indeed, it was

CASE II.   Mrs. E. S. (Fig. 2.) This forty-two year old white female was admitted to St. Luke's Hospital on January 12, 1945, and was operated upon the following morning through a lower midline incision, at which time a total abdominal hysterectomy was carried out. All minor vessels were ligated with No. 0000 Deknatel silk while No. 000 Deknatel silk was used to ligate the uterine vessels. Closure was affected with a continuous suture of chromic No. 0 catgut in the peritoneum, and interrupted sutures of No. 000 Deknatel silk in the fascia and skin. Her general reaction as observed on the accompanying temperature chart was minimal. On the morning and again in the evening of the second postoperative day the patient was allowed to sit in a chair for a period of thirty minutes at a time. The following day or three days after operation she again sat in a chair, this time for a period of an hour, and in addition was assisted in walking to the bathroom to evacuate an enema that had been administered. She became completely ambulant thereafter and was discharged from the hospital on her seventh postoperative day. Her wound healed per primam; there were no

complications of any kind; and her morale throughout the entire postoperative period was excellent.

to the bathroom with help. On the third day following surgery she walked to the bathroom unaided and had a normal spontaneous defeca-
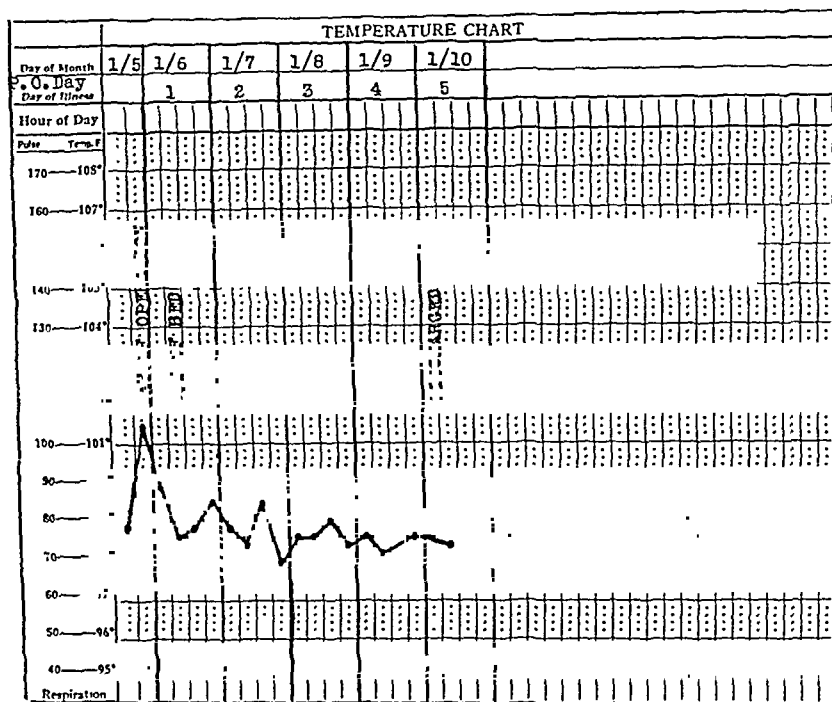

FIG. 5.

CASE III. Mrs. J. F. (Fig. 3.) This patient is a sixty-eight year old short, fat female who was admitted to the Miller Memorial Hospital on March 27, 1945, with a history of severe and repeated gallbladder colics which extended over the past two years. We anticipated some difficulty following surgery because of an associated grade 3 hypertensive cardiovascular disease. After several days' preparation she was operated upon on April 2, 1945, under local block anesthesia. Through an upper right rectus incision her gallbladder was easily removed. All minor vessels were ligated with No. 0000 Deknatel silk. The cystic duct and artery were individually ligated with No. 000 Deknatel silk. Closure was again affected with a continuous suture of chromic No. 0 catgut in the peritoneum and posterior rectus sheath, and interrupted sutures of No. 000 Deknatel silk in the anterior rectus sheath and skin. A single penrose drain was placed down to Morrison's pouch. The patient was allowed up in a chair for thirty minutes on the morning of the first postoperative day. On the second postoperative day she was allowed up in a chair for a slightly longer period of time and in addition walked

tion. She gradually became completely ambulatory thereafter. Observing the accompanying chart you will note that her postoperative course was most mild and uneventful. She developed no evidence of circulatory or pulmonary complication, and her morale was excellent. The single drain and all skin sutures were removed on the tenth day, and the wound healed by primary union.

CASE IV. Mrs. E. J. (Fig. 4.) This fifty-two year old white female was admitted to St. Mary's Hospital on February 13, 1945, and was operated on the following morning. She had a moderate degree of uterine prolapse with an associated moderate cystocele and rectocele formation, for which a Manchester type of repair with amputation of the cervix was carried out. Chromic No. 0 catgut was used for the repair. On the third postoperative day she was allowed out of bed for the first time when she sat in a chair for a period of thirty minutes. The following day she was up in a chair for a somewhat longer period of time and in addition was assisted in taking a few steps. Thereafter she gradually became completely ambulant and was allowed to leave

the hospital on the sixth postoperative day. Her postoperative course as represented by the accompanying temperature chart was definitely

following day he was assisted in walking to the bathroom and again was allowed to sit in a chair. He thereafter was up and about as he
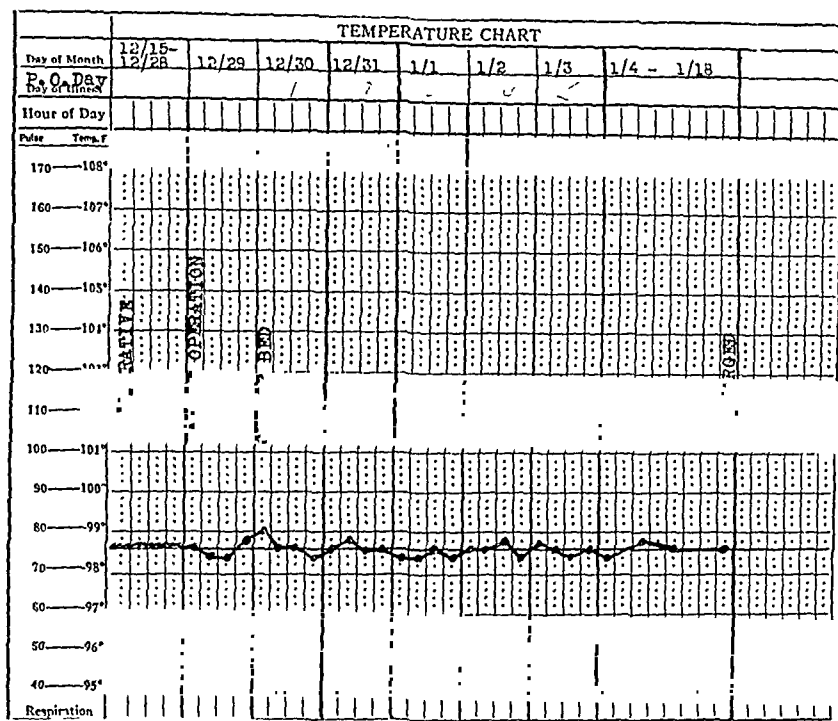

FIG. 6.

milder than our cases of vaginal plastics confined to bed for a customary period of ten to twelve days. Her morale was excellent; all wounds healed normally; and to date there is no evidence of harm resulting from the early activity.

CASE V. A. B. (Fig. 5.) This case was included among our series of appendectomies but is presented separately at this time because it portrays so well the mildness of the postoperative course and the rapid rehabilitation resulting from early ambulation following surgery on an elderly patient. The patient is a seventy-eight year old white male admitted to St. Mary's Hospital on the afternoon of January 5, 1945, and operated on the same evening under local block anesthesia at which time an acute gangrenous appendix was removed through a McBurney incision. The abdominal wound was closed with a running suture of chromic No. o catgut in the peritoneum and interrupted sutures of the same in the muscle and fascial planes. The following morning, or some ten hours following surgery he was allowed to sit in a chair for a few moments and to stand beside the bed to void. The

desired until his discharge from the hospital on the morning of his fifth postoperative day. As you will note from his temperature chart, his postoperative course was extremely mild. His morale was excellent; he required only one hypodermic injection of morphine in the entire postoperative period, and he experienced no difficulty in bladder control. His skin sutures were removed at the office on his eighth postoperative day and the wound had healed per primam. He returned to his usual occupation as custodian of a building on the tenth day following surgery.

CASE VI. A. T. (Fig. 6.) This case is likewise presented because it demonstrates so well the absence of postoperative complications when early postoperative activity is permitted following surgery on elderly patients. The patient is an eighty-five year old white female who was admitted to the Miller Memorial Hospital on December 15, 1944. She had a large hernia in a McBurney incision with an extremely small neck and evidences of repeated incarceration. She was operated upon on December 29, 1944, under local block anesthesia, and the hernia was repaired after

reduction of its contents. No. ooooo Deknatel silk was employed in ligating all minor bleeding points, and No. oooo Deknatel silk was used

being presented because it indicates that selected cases undergoing major gastrointestinal surgery may be ambulated earlier, in the
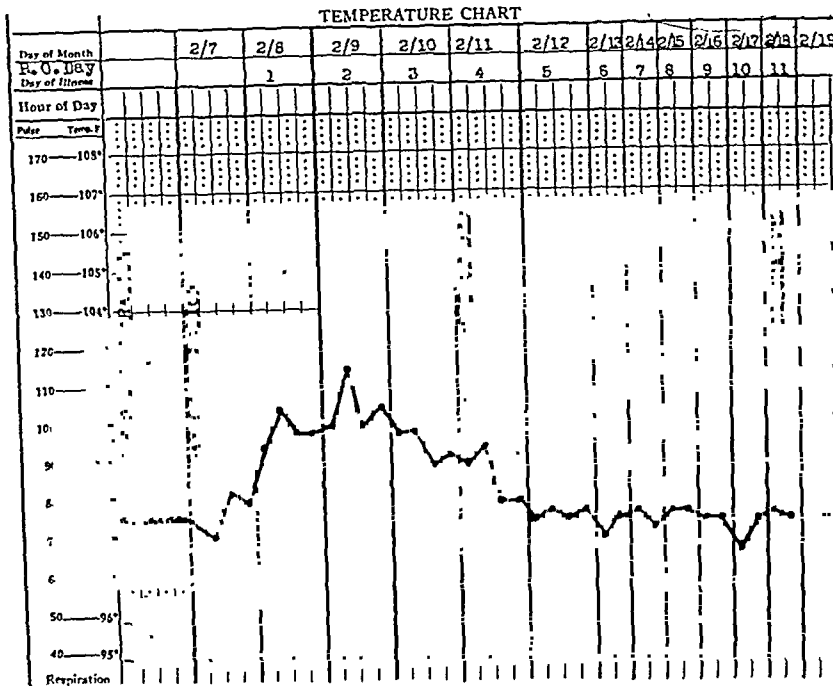

FIG. 7.

for the repair. The patient was allowed to sit in a chair the following morning while the nurses changed her bed. On the second postoperative day she was allowed to sit in a chair for a slightly longer period of time both in the morning and again in the afternoon, and on the third day following surgery she walked to the bathroom with assistance where she had a normal spontaneous defecation. Thereafter she was up for gradually longer periods of time until she became completely ambulatory. Her postoperative course, as you will observe on the accompanying temperature chart, was extremely mild and uncomplicated, her highest postoperative temperature reading being 99°F. Her skin sutures were removed on the tenth postoperative day and the wound had healed by primary union. She was allowed to remain in the hospital much longer than customary because she was a County case who lived alone, and we did not want her to leave the hospital until she was sufficiently well to care for herself. She has been seen frequently since discharge from the hospital, and to date there is no evidence of recurrence of the hernia.

CASE VII. N. T. (Fig. 7.) While this case was not activated as early as the others, it is

absence of definite contraindications, without serious sequelae and resulting in an earlier rehabilitation of the patient. The case is that of a thirty-five year old white male who developed a large gastrojejunal ulcer seventeen years after a gastroenterostomy had been done for a duodenal ulcer. He was operated upon on February 7, 1945, through a left oblique incision. The previous gastroenterostomy was taken down and a high gastric resection was done. Closure of the abdominal wound was affected with a running suture of chromic No. o catgut in the peritoneum and interrupted sutures of No. ooo Deknatel silk in the fascia and skin. His early postoperative reaction was about that usually observed following an operation of this magnitude. By the fourth postoperative day his condition was so good that we elected to allow him out of bed. On this occasion he sat in a chair for a period of approximately twenty minutes. The following day he was allowed to sit in a chair for thirty minutes both in the morning and in the afternoon, and on his sixth postoperative day he walked to the bathroom with assistance. Thereafter he became completely ambulant and was discharged from the hospital on the eleventh

postoperative day. The same day he made a trip to Minneapolis, to witness the Golden Gloves Tournament, with apparently no harmful effects resulting. His wound healed perfectly, and he has had no complications to date either recent or remote. The most striking feature of this case was the remarkable feeling of well-being and the absence of muscular fatigue and weakness that is so commonly exhibited following confinement to bed for longer periods of time.

ADVANTAGES OF EARLY AMBULATION

The manifest advantages of early postoperative ambulation are several (Table II) and naturally fall into various groups which Powers[7] has designated as physiologic, psychologic, and economic.

TABLE II
ADVANTAGES OF EARLY AMBULATION
(after Powers)
I. Physiologic considerations
   a. Pulmonary
   b. Circulatory
   c. Gastrointestinal
   d. Musculoskeletal
   e. Reparative
II. Psychologic aspects
III. Economic

Probably the most important of these factors to be considered is that which concerns the reparative processes in relation to early rising. While Newburger[8] has presented some convincing evidence to indicate that abdominal wounds heal even more kindly when early postoperative activity is practiced and has presented further experimental evidence to suggest that abdominal wounds in animals subjected to early ambulation possess· in fact a greater degree of strength and resistive quality, the important factor to consider is that there is no evidence thus far adduced to show that early ambulatory activity in any way interferes with firm normal healing of wounds *provided* there has been an accurate anatomical closure of the wound according to the dictates of good surgical principles and provided infection or gross contamination of the wound has been avoided. All of the reports in the literature, submitted by those who have extensively employed it, showed no resulting deleterious effects such as increase in incisional pain, wound disruption, or incisional hernia. Thus we may conclude that even assuming no advantages to wound healing from such a program, it is definitely established that it presents no objectionable feature in the form of interference with the integrity of normal wound repair.

The advantages referable to the musculoskeletal system are evident in nearly all of the cases. The striking absence of asthenia so commonly noticeable after operations accompanied by enforced bed rest for the customary period of time is a prominent and gratifying feature to both the patient and his physician. In addition, the absence of asthenia plus the increased muscular activity reduces the period of reconditioning before a return to normal activity by about one-half. (Nearly every patient when reporting to the office for his first dressing, asked how soon he could go back to work.)

Early ambulation promotes a beneficial effect on the function of 'the gastrointestinal tract. Those who have observed large numbers of cases report that abdominal distention and postoperative gastrointestinal dysfunction is rare. The patient feels better, has an improved outlook, and his gastrointestinal apparatus functions more normally earlier in the postoperative period. As a result, enemas, hot stupes, and the like become increasingly unnecessary. Our experiences coincide with that in that in no case was there evidence of disturbed gastrointestinal function.

Of all of the advantages of early ambulation probably none is so important to the prevention of catastrophic complications as the beneficial effect it promotes in the reduction of cardiovascular and pulmonary complications.

It is physiologically established that rest in bed in the recumbent position favors elevation of the diaphragm, pooling of the tracheobronchial secretion, limitation of maximal respiratory excursion and reduc-

tion of vital capacity of the lungs. These factors, together with a natural disinclination to cough, all play an important rôle in the etiology of postoperative atelectasis and pneumonia. In contradistinction to this, it has been experimentally and clinically shown that the volume of tidal air, tension of oxygen in the alveolar spaces, oxygen saturation of the blood, and depth and rate of respiratory movements are all increased by exercise and hence are of value in reducing the incidence of postoperative pulmonary complications. Furthermore the decreased necessity for the use of morphine, as indicated in our cases, is another aid in disposing of a factor generally considered to be important in the production of atelectasis because of its effect in reducing respiratory excursion and limiting the cough reflex. In this connection we would like to add that Leithauser has suggested that if the patient be urged to cough on his first out-of-bed period, it is amazing how many times he will expectorate a mucous plug.

Of the vascular complications the one that concerns us the most is the prevention of vascular stasis and associated intravascular clotting. Of the three factors responsible for venous thromboses, namely, slowing of the circulation, changes in the vessel wall, and increased coagulability of the blood, slowing of the circulation seems to be the most important. Retardation of the blood flow is directly related to immobility and bed rest, and such a circumstance is considered to be the common denominator of phlebothrombosis and pulmonary embolism. While early mobilization of the patient is not the entire answer to the problem, it certainly does increase the circulation in the extremities and helps to forestall any such complication.

Psychologically, these patients present a picture of improved morale. Furthermore, they learn not to fear surgery and if subsequent operations become necessary at a later date, they approach them calmly in the knowledge that the dis-comforts of convalescence may be largely eliminated by a program of accelerated activity.

CONTRAINDICATIONS

There are only a relatively few contraindications to early ambulation, and these are usually self-evident. The most notable of these are shock, severe anemia, cardiac insufficiency, hemorrhage, peritonitis, insecure gastrointestinal anastomosis, and the presence or suspected presence of thrombi or emboli. Marked abdominal distention and prolonged preoperative confinement to bed are also considered by some to preclude early postoperative activity. Copious tamponade or drainage of the abdominal cavity are considered contraindications, but the employment of a single drain offers no impediment to it.

CONCLUSIONS

In conclusion we have discussed the literature and presented our experiences with early ambulation in surgical cases. We believe that it offers advantages to the patient and lessens the incidence of serious postoperative complications, and are of the opinion that it is worthy of further trial and evaluation.

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OBSCURE CAUSES OF INTRA-ABDOMINAL HEMORRHAGE*

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HEMOPERITONEUM is sometimes caused by pathological states which remain hidden even from the most experienced surgeon. In other cases, the causes may be obvious diseases. In this latter group one might recall eroding primary and metastatic tumors of the liver, spleen, pancreas, kidneys and ovaries; pathological or traumatic rupture of a viscus; ectopic pregnancy; pancreatitis; infarcts of the kidney and spleen caused by emboli arising in recognized sources; stab and gunshot wounds and mangling accidents. This paper is concerned with the former group.

For the sake of localization of the various lesions to follow, the causes of hemoperitoneum are grouped under upper abdominal, lower abdominal and pelvic areas. These various regions might be arbitrarily separated by lines drawn transversely through the umbilicus and the superior boundary of the pelvis.

Upper abdominal causes are: (1) Varices of the diaphragm and round ligament; (2) subserosal varices; visceral, mesenteric and omental; (3) dissecting or luetic aneurysm of aorta, superior mesenteric artery, celiac axis and radicles; (4) angioma of the liver and spleen.

Lower abdominal causes are: (1) subserosal varices; visceral, omental and mesenteric; (2) ruptured inferior epigastric vein.[13]

Pelvic causes are: (1) Ruptured Graffian follicles, corpora lutea, and cysts; (2) strangulation, ovary and ovarian cysts; (3) rupture of uterine vein in pregnancy; (4) rupture of a vein on a uterine fibroid (Case III).

Examples of many of these causative lesions have been gleaned from the literature, the autopsy file and clinical records of the University of Maryland School of Medicine and Hospital.

INCIDENCE OF HEMOPERITONEUM IN GENERAL HOSPITAL ADMISSIONS

To compile information relative to the incidence of hemoperitoneum, the total admissions to the University Hospital during the eighteen years, 1926 to 1944, were reviewed. In that period thirty-seven cases were listed in which hemoperitoneum appeared as a major diagnosis. This group does not include hydroperitoneum in which slightly discolored fluid was present, but only those cases in which whole blood or nearly whole coagulable blood was found in the peritoneal cavity. In all instances hemorrhage into the peritoneal cavity was the immediate cause of hospitalization or death.

Of the thirty-seven cases, seven were due to ectopic gestation; four were due to eroding tumor of the liver or tumor necrosis; ruptured Graffian follicle, four; gunshot wounds, three; knife wounds, two; traumatic rupture of kidney, spleen and liver, one; traumatic rupture of spleen, one; eroding tumor of the pancreas or tumor necrosis, one; traumatic rupture of liver, two; intrapartem rupture of uterus, one; perforated ulcer, one; ruptured vein on uterine fibromas, one; traumatic rupture of subserous mesenteric or omental vessels, two cases; ruptured luetic aneurysm, one (Case II); laceration of the urinary bladder, three; dissecting aneurysm of aorta, one; bleeding from the head of the pancreas following gastric resection, one (Case IV); and ruptured varices of the diaphragm, one

case (Case 1). Review of the literature reveals other obscure causes of hemoperitoneum not seen in this hospital.

Rupture of a tributary of the middle colic vein with hematoma formation in the transverse mesocolon has been recorded by Herman.[9] Berk et al.,[2] under the title "Intra-abdominal Apoplexy" report an abdominal vascular accident leading to hemoperitoneum in a fifty-two year old male. The basis of the vessel rupture was probably arteriosclerosis. He states after reviewing a series of cases, that such abdominal disease arises most commonly in males of ages between forty-five to fifty-five years. Hypertension was present in 50 per cent of their cases. It is interesting to note that during abdominal exploration no definite bleeding point could be found in 30 per cent of the cases. The average age in this 30 per cent was said to be 41.5 years, while the remaining groups in which definite bleeding points were discovered were of the average age fifty-five to fifty-six years. Arteriosclerosis prevented retraction of the bleeding vessel in the latter group, but in the former retraction did occur obscuring the bleeding point. Bunch et al.,[3] in discussing spontaneous intra-abdominal bleeding also note the frequency of arteriosclerosis and hypertension in cases of apoplectic abdomens. He names, as the arteries from which bleeding is more likely to occur, branches of the celiac axis and the superior mesenteric artery.

In cases in which the bleeding point is not manifest, Bunch et al. suggested further exploration for ectopic pregnancy and spontaneous rupture of the liver, spleen and pancreas be done in cases of spontaneous hemoperitoneum. Thus, in such cases, meticulous examination of the liver and spleen may be rewarded by finding evidence of hemangioma or infarct as a basis for the "spontaneous" rupture. It is difficult to believe that an organ can rupture without some underlying pathological condition.

Further cases of so-called spontaneous rupture of visceral vessels have been reported by Crile et al.[5] Bruce[4] has reported a massive spontaneous intraperitoneal hemorrhage arising from an aneurysm of the middle colic artery. Cushman and Kilgore[6] have recorded twenty-one cases of spontaneous abdominal hemorrhage without previous aneurysm or laceration of the vessel in question. Here again it is prudent to cast doubt on the rupture of normal vessels, particularly arteries. It appears more credible to consider such ruptures occurring as the result of a dissecting aneurysm or arteriosclerosis.

Cushman and Kilgore, in agreement with Bunch et al., state that four-fifths of the cases reported by them exhibited arteriosclerosis and one-third had hypertension. Their cases occurred more frequently in males than females of the average age of fifty-three years. They suggested that trauma or strain may be significant in initiating the rupture, but excluded from the history of patients with spontaneous abdominal hemorrhage because of oversight. Conditions such as vomiting, eating or purging which have little significance to the patient may be important.

Although hemoperitoneum caused by ruptured ovarian follicles and corpora lutea are well recognized, a case reported by Foise[7] is mentioned since the patient was only twelve years old. Her illness resulted from a corpus luteum which ruptured one month after the menarche or immediately before the second period.

Hoffman[11] has given complete report of ruptured Graffian follicles and corpus luteum cysts with intraperitoneal hemorrhage. It was stated that the right ovary was involved twenty-seven times in his series, the left only six times. In this group of cases, ruptured follicular cysts occurred eighteen times, ruptured corpora lutea fifteen times. The patients ranged between fifteen and twenty-five years in age. It was mentioned that right lower quadrant pain was most common, but pain could be bilateral or epigastric. Even

when the left ovary is the site of the lesion, pain may be experienced on the right side. This condition of ruptured corpora lutea, ruptured ovarian cysts and bleeding post ovulatory follicles must be differentiated from acute appendicitis, ectopic pregnancy, acute salpingo-oophoritis, mesenteric adenitis, pelvic abscess and strangulated pedunculated ovarian cysts.

Hickman et al.[10] have reported strangulation and rupture of a normal ovary in an eight year old girl which led to hemoperitoneum. Bach and Montgomery,[1] have reported hemoperitoneum arising from the rupture of an infarcted granulosa cell tumor.

Bleeding into the peritoneal cavity from a ruptured uterine vein in pregnancy has been seen by Harding.[8] Schneider et al.[15] have seen a similar accident in a forty year old colored woman in whom bleeding occurred from a dilated vein on a uterus containing fibromyomas. In this patient 2 liters of bloody fluid were present in the abdominal cavity. Shock was prompt in onset and marked in degree.

SIGNS AND SYMPTOMS

Following extravasation of blood into the peritoneal cavity, evidence of peritoneal irritation with splinting of the abdominal wall, tenderness, mild leucocytosis and low grade fever occurs. The course thereafter depends upon the position of the bleeding point, and whether the bleeding is within a confined space or free into the abdominal cavity.

In such instances in which bleeding occurs immediately into the peritoneal cavity, the above signs appear with shock developing with a rapidity parallel to that of exsanguination. This may be the case in rupture of subserosal veins, and bleeding from ovarian cysts and follicles. Not infrequently the onset of shock is insidious. It may become apparent and rapidly develop days or weeks after the onset of the illness.[6,9] Delayed development of vascular collapse may be due to dislodgement of a clot with secondary

hemorrhage or it may be the result of an increase in the size of the bleeding defect incident to hypertension following stress.[6]

Intra-abdominal hemorrhage sometimes occurs from vessels in the proximity of abdominal viscera which leads to dissection of the areolar tissue plane and separation of the peritoneum from underlying tissue. As the extravasated blood pours into the advancing space a hematoma is formed which finally exerts pressure leading to symptoms characteristic of the organ involved. Symptoms suggestive of gastrointestinal obstruction may appear with persistent or repeated vomiting. If the bowel is impinged upon by the growing hematoma, there may be an urge to evacuate. This urge is usually one which is false. If defecation is accomplished, it affords no relief of the abdominal distress. Coincident with the rupture of the vessel, sudden sharp pain is experienced. As the hematoma enlarges, distress resulting from the stretching peritoneum appears and regresses repeatedly as the hemorrhage is arrested and begun again. However, when the serosa is distended to its maximum capacity, rupture of the peritoneum and discharge of blood into the peritoneal cavity occurs causing a sudden, sharp, lancinating exacerbation of pain. Thereafter shock appears promptly and rapidly increases in depth.[6]

CASE REPORTS

A case of diaphragmatic varices was discovered in our autopsy experience in which a large hematoma of the diaphragm had developed subsequent to rupture of a varix. Spilling of blood into the peritoneal and thoracic cavities resulted. An abstract of this case follows:

CASE I. This patient was a forty-four year old colored male who was admitted to the University Hospital with a complaint of generalized discomfort of six weeks duration which developed gradually. The patient noticed weakness and vague pains which he explained on the basis of "grippe." On occasion he experienced sharp, stabbing pains in the chest and ab-

domen. Nausea and vomiting, shortness of breath and "quivering of the heart" occurred. Physical examination revealed a dullness over the right hemithorax. The diaphragm was fixed. Blood pressure readings in the right arm were 158/74 and in the left arm 172/70. Abdominal distention and shifting dullness were discovered. Muscle spasm was noted in the abdominal examination. The non-protein nitrogen level was 74 mg. per cent; hemoglobin 74 per cent; red blood cell count 3,370,000; white blood cells 20,100 of which 94 per cent were polymorphonuclear neutrophilic granulocytes. On the third day after admission the hemoglobin level dropped to 60 per cent. Intense pain developed in the region of the right clavicle and right upper quadrant of the abdomen. On the fourth day after admission, death occurred. During the hospital course the blood pressure ranged from 120 to 170 mm. mercury.

At autopsy, dilated tortuous veins, the source of the hemorrhage, were found on the superior and inferior surfaces of the diaphragm and hemoperitoneum (800 cc.), hemothorax on the right side (800 cc.), hydrohemothorax on the left side (400 cc.), and hematoma of the diaphragm were recorded. A luetic aneurysm of the ascending aorta and cardiac hypertrophy were present also.

For further details of the above case, the reader is referred to a report written by Palmer and Leitch.[12]

CASE II. T. J., a forty year old colored laborer was first admitted on April 19, 1941, with a complaint of left lower chest pain of five days duration, night sweats, cough and shortness of breath. The present illness began five days prior to admission with the onset of pain in the left lower chest, persistent unproductive cough, repeated chilly sensations and night sweats, and progressive shortness of breath even on mild exertion.

On admission the temperature was 101°F., pulse 120, respirations 32 and blood pressure 106/24. The physical examination revealed a well developed, fairly well nourished colored male in obvious respiratory distress. The chest was symmetrical. A definite fixation of the diaphragm was demonstrated on the left side. The percussion note was dull over the same half of the chest on its posterior axillary aspect, and over the same area the breath sounds were tubular and somewhat obscured

by numerous fine râles. The heart examination was normal. The abdomen was flat and well muscled. The liver, spleen and kidneys were not palpable. No masses, tenderness or rigidity were present.

An x-ray of the chest on April 19, 1941, showed homogeneous clouding in the left base and moderate tortuosity of the aorta with a mass to the right of the mediastinum. On April 28, 1941, another x-ray showed resolving pneumonia of the left base with widening of the ascending aorta.

The laboratory reported a hemoglobin of 100 per cent; red blood count 5,200,000; white blood count 21,000, polymorphonuclear granulocytes 84 per cent, lymphocytes 14 per cent, and monocytes 2 per cent. The urine and stools were negative. The sputum contained blood and numerous type 14 pneumococci. Blood cultures were negative. The serological test for syphilis was found positive on two occasions.

The patient was treated for pneumonia by giving sulfapyradine in the usual doses. The temperature returned to normal in thirty-six hours. The white blood count fell steadily until April 28, 1941, when it was 8,650. The same day the patient complained of constipation and upper quadrant pain which was relieved by enemas. The next three days were uneventful and the patient was discharged on April 31st as cured.

Readmission on May 3, 1941, was arranged because the upper left quadrant pain had returned more severely than before. The patient had vomited on several occasions and hiccoughs appeared and persisted. On this admission, the pulse was 110, temperature 98.9°F., respirations 30, blood pressure 142/62. A tender mass in the left upper quadrant of the abdomen about 10 by 10 cm. showed questionable pulsations. The abdomen was distended but silent. Blood studies showed hemoglobin of 70 per cent; lymphocytes 24 per cent. Phenolsulfonphthalein was 82 per cent in two hours. An x-ray of the chest showed further resolution of the pneumonia. The lumbar spine was negative. A flat plate of the abdomen showed a distended large bowel and a mass in the left upper quadrant measuring 15 by 8 cm., which displaced the stomach to the left. It was questionably expansile.

Repeated enemas were only partially effectual. Abdominal pain and tenderness persisted.

Irregular fever mounted to 101°F. The white blood count rose slowly to 23,400. Blood cultures were negative.

On May 6, 1941, an exploratory laparotomy was done, finding an inflammatory mass occupying the lesser omental space with what appeared to be transmitted pulsations. Biopsy of the mass and pancreatic tissue was obtained. Serosanguineous fluid was aspirated from the mass. The patient was closed without further procedure. A smear of fluid showed numerous type 12 pneumococci.

The patient was given sulfapyradine intravenously and anti-pneumococcus serum (300,-000 units). The temperature continued to spike to 101°F. The white blood cell count ranged between 18,000 and 26,000. The patient's general condition seemed to improve. On the fifth postoperative day, the patient got up out of bed and walked to the bath room. Shortly thereafter, he complained of pain in the right upper quadrant and went into shock. Usual methods of shock treatment failed. The patient died two hours later.

At autopsy the peritoneal cavity was found to contain 500 to 600 cc. of blood tinged fluid, also very large fresh blood clots, the largest approximately the size of the liver. These were found on the right side beneath the liver in the left colic gutter and pelvis. The abdominal wound was well healed. A large grapefruit-sized mass was present in the upper abdomen, adherent to the stomach, duodenum, liver, pancreas and spleen. The omental bursa was distended with about 500 cc. of faintly blood tinged fluid. The mass, which was in the omental bursa, contained several silk sutures placed there at operation. No evidence of bleeding was seen here.

Each of the pleural cavities contained about 50 cc. of clear, straw colored fluid. Many adhesions were found over the left base and an exudative reaction between the base of the left lung and pleural surface of the diaphragm were noted. The whole gastrointestinal tract was separated away from the mass which was found to be situated directly in the midline and too intimately involved with the pancreas to permit separation. After the gastrointestinal tract was removed the aorta was found to have a distinct aneurysmal bulge at its arch. It was found that the abdominal aorta was intimately involved with the undersurface of the mass. The aorta, pancreas and tumor were removed

as one with enlarged periaortic lymph glands. The aorta was opened on its posterior surface. In the region of the celiac axis an aperture was found measuring 4.5 by 2.5 cm. It laid directly under and communicated with the aneurysmal mass, which was the source of the bleeding. The aorta presented characteristics typical of syphilitic aortitis.

CASE III. J. W., a forty year old colored female was admitted to the gynecological service on August 24, 1942, with a complaint of a mass in her lower abdomen of several months' duration, recent urinary difficulty and a life-long constipation which had suddenly become worse. During bowel movements intense rectal and low back pain occurred. Three days previous to admission the patient lifted a tub of water and was struck with a severe lower abdominal cramp. This became more severe so she came to the accident room.

The patient gave a history of rheumatic fever. While a child she was told she had a "bad heart" for which she was never treated.

On admission the temperature was 100.2°F., pulse 88, respirations 20 and blood pressure 130/80. An examination revealed a forty year old, mulatto, rather emaciated woman lying quietly in bed complaining of a tender abdominal mass. Examination of the heart and lungs revealed no noteworthy features. The abdomen was prominent and very tender to palpation below the umbilicus. The liver edge extended 1 to 2 cm. below the right costal margin. The spleen and kidneys were not palpable. A nodular fixed mass was palpable which seemed to rise from the pelvis. It extended to the umbilicus and into both flanks. A pelvic examination revealed a stony hard nodular mass in the vault of the vagina. The cervix was normal in appearance. The digital examination of the rectum revealed no noteworthy findings. The extremities and reflexes were normal.

The laboratory findings included hemoglobin 90 per cent; red blood count 4.6 million, and white blood count 10,900 with a normal differential. The urine and stool examinations were essentially negative. X-ray examinations of the chest demonstrated no abnormalities.

The diagnosis of uterine fibroids was made. Under general anesthesia the abdomen was prepared in the routine manner and a low left paramedian incision was made. The peritoneum was opened and about 200 to 300 cc. of old

clotted and free blood was found. There were several large fibroids present. The veins of one of these had been eroded by pressure. This was the source of the bleeding. A routine pan-hysterectomy and appendectomy was done. The patient was returned to the ward in good condition, and after an uneventful postoperative course was discharged September 8, 1942, as improved.

CASE IV. J. O., a fifty-two year old white male, was admitted on May 6, 1942, with a complaint of upper left quadrant abdominal pain for the past three years and vomiting blood with fainting spells of two days' duration.

Three years ago the patient had noticed pain which was not related to meals in his left upper quadrant which occasionally radiated to his epigastrium. He was seen at the University Gastrointestinal clinic, where a diagnosis of chronic gastritis was made. As the above symptoms did not subside, he was admitted to the hospital for further treatment.

On admission the pulse was 84, respirations 20, temperature 99°F., and blood pressure 130/90. The patient was found lying quietly in bed in no apparent pain or distress. The abdomen showed no definite tenderness or rigidity. The liver, spleen and kidney areas were normal.

On June 18, 1942, a gastrointestinal series showed a penetrating, probably malignant, gastric ulcer on the greater curvature.

Repeated urine examinations were negative. All stools gave a 4 plus benzedine test, and on one occasion a 4 plus Guaiac test. Blood studies revealed a red blood count of 4.72 million, white blood count 12,850; hemoglobin 90 per cent; platelets 623,040; prothrombin time twenty-two seconds; bleeding time three minutes fifteen seconds; and clotting time five minutes fifteen seconds. Blood chemistry was normal except for an elevated non-protein nitrogen, varying from 36 to 41 mg. per cent.

On June 20, 1942 a subtotal gastrectomy was performed. A biopsy of the gastric lesion showed inflammatory tissue. The patient had a rather stormy course postoperatively. Shock therapy was necessary. He responded fairly well and showed gradual improvement until the sixth day. At that time the total proteins had dropped from 6.78 to 3.52 mg. per cent. It was thought advisable to give the patient 1,000 cc. of whole blood. Previous to the transfusion the chest manifested no significant

abnormalities. After 750 cc. of blood had been slowly administered the patient felt that the transfusion was weakening him and making it hard for him to breathe. The transfusion was discontinued at this time. One hour later the patient was again seen and was still complaining of difficult breathing. Examination of the chest revealed nothing of significance. The pulse rate was 86; the volume, good. Five minutes later the pulse became rapid and thready. The patient suffered acute respiratory distress and expired a few moments later.

At autopsy the abdomen was found to contain a large amount of grossly bloody fluid, measuring approximately 2 liters. Generalized old and fresh adhesions were found throughout the abdominal organs and pelvis. The pylorus had been resected and an anterior gastro-jejunostomy performed. All suture lines were secure and apparently well healed. Inspection of the pancreas revealed a portion excised and subsequently sutured. At the suture line there was an adherent solid clot extending down to the incision. There was no evidence of obstruction along the operative site. The ostium was of good size and patent. The pancreas was removed and in the region of the body the 3 cm. incision which had been sutured was found. There was evidence of a bleeding point within it. Also in this area some infiltration with a hemorrhagic exudate was found. A microscopic section of the pancreas exhibited extensive necrosis, edema and autodigestion. The line of incision was filled with amorphous necrotic material. There was also seen numerous areas of fibrosis, fat necrosis and hemorrhagic extravasation. The islets appeared edematous and less cellular than usual.

SUMMARY

1. Spontaneous intra-abdominal hemorrhage results in findings characteristic of acute abdominal disease.

2. Abdominal arteries, particularly the superior mesenteric, middle colic and celiac arteries and aorta may rupture, apparently spontaneously, and result in massive hemoperitoneum. This type of accident is often associated with hypertension, arteriosclerosis and less frequently with dissecting or luetic aneurysm. Such an occurrence is most commonly seen in males at the age of forty-five to fifty-five years.

3. Minor injury and strain incited by vomiting or purging may initiate the rupture of a weakened vessel and influence the extent and course of the hemorrhage.

4. Subserosal and mesenteric varices may rupture and lead to fatal hemoperitoneum.

5. Numerous causes of hemoperitoneum (some easily diagnosed, others with great difficulty) must be differentiated.

6. The signs and symptoms of hemoperitoneum are briefly discussed.

7. The blood pressure may be normal early in the course of a patient with intra-abdominal bleeding depending on the rapidity of bleeding and volume of blood lost.

8. When spontaneous hemoperitoneum is suspected, frequent blood pressure readings should be taken since the blood pressure fall may precipitously occur at variable periods after the onset of symptoms.

9. Cases of hemoperitoneum, due to obscure causes, are reported.

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ARTHROTOMY APPROACHES IN THE LOWER EXTREMITY*

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ADEQUATE surgical exposure of the major joints is a difficult procedure. The multiple neurovascular structures about the joints make incision hazardous and the architecture of a joint with its necessary stabilizing ligamentous structure does not contribute to ease of visualization of the complex mechanism.

There are a multitude of surgical approaches described and used in the lower extremities but the lack of common knowledge and use of the principle of resection or bone attachment of muscle or tendon to approach these joints has prompted this brief summary.

Approach to the ankle and tarsal area is commonly done by use of the Kocher lateral or the anterior longitudinal incision. Resection of the fibula has been advised. It is a simple matter to combine the advantages of the three methods in an s-shaped incision extending laterally from the navicular tubercle then up, over, and down behind the fibular malleolus. (Fig 1.) The fibula is osteotomized proximal to the epiphyseal line and reflected distally with its attached ligaments. The long toe extensors are retracted medially and the short extensors are elevated at their origin in the usual fashion. This approach particularly facilitates the exposure of the posterior portion of the ankle and subtalar joints. The fibula is replaced with a heavy nylon suture, metal nail, or screw to the tibia and with the usual layer closure it has been our experience that a more satisfactory scar results than with the line of incision distal to the fibular malleolus. External plaster fixation is usually necessary but often slab splints with compression bandages are more satisfactory than closed casts.

Knee arthrotomy is usually performed through the parapatellar or split patellar route. Recently section of the quadriceps tendon superior to the patella has been advised. Here again a combination of advantages is possible by use of the straight anterior longitudinal incision, v-resection of the tibial tubercle and joint capsule, and reflection of the patella upward.[1] (Fig. 2.) This is particularly effective for synovectomy, reconstruction, osteotomy or open reduction of fractures of the distal third of the femur involving the joint. The incision is closed by nailing the tibial tubercule back in place, tight suture of the capsule, and layer closure. Early postoperative motion may be instituted in some cases. A firm, well padded, compression dressing is very important.

Exposure of the hip is difficult mechanically, may be shocking, and may be attended by major blood loss. The technic of osseous tendon attachment reflection appears to afford a minimum surgical morbidity with maximum exposure.[2] The skin incision extends distally from the anterior superior iliac spine to the trochanter and turns distally in the line of the femur. (Fig. 3.) The anterior superior spine is reflected with its attached sartorius, the inferior spine with the rectus, and the trochanter with the gluteals. One large circumflex vessel group is ligated where it passes anterior to the femur neck. Section of the capsule then exposes the joint. Congenital or traumatic dislocation reductions or reconstruction can be performed readily through the approach. Closure requires only replacement of the iliac spines with heavy sutures or nails, replacement of the trochanter with a nail and layer suture. Early mobility is possible when desired.

ANKLE APPROACH
ANTERIOR

INCISION

TIBIA
FIBULA
TALUS
CALCANEUM
NAVICULAR
MID CUNEIFORM
EXT CUNEIFORM
CUBOID

RESECTION OF
LOWER EXTREMITY
OF THE FIBULA
PERMITTING RE-
FLECTION OF THE
LATERAL MALLEOLUS
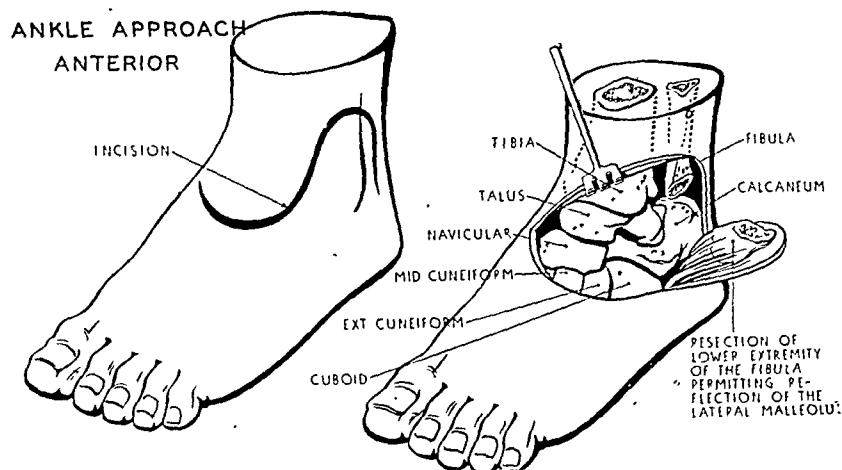
FIG. 1. Arthrotomy of the ankle.

KNEE APPROACH ANTERIOR

OUTLINE
OF THE
PATELLA

INCISION
IN RELATION
TO THE
PATELLA

REFLECTION OF
THE PATELLA
BY BONE RE-
SECTION AT
POINT OF AT-
TACHMENT OF
THE LIGAMENTUM
PATELLÆ

POSTERIOR
CRUCIAL
LIGAMENT

CAPSULE
SUTURED

ANTERIOR
CRUCIAL
LIGAMENT

TUBERCLE
REPLACED
WITH NAIL

FIG. 2. Arthrotomy of the knee.

HIP APPROACH
ANTERIOR

INCISION

GLUTAEUS
MEDIUS
REFLECTED

MUSCLE
REPLACEMENT
BY NAIL

ANTERIOR ASPECT
OF INCISION IN
RELATION TO THE
PELVIS

RECTUS FEMORIS
REFLECTED

SARTORIUS
REFLECTED

CAPSULAR
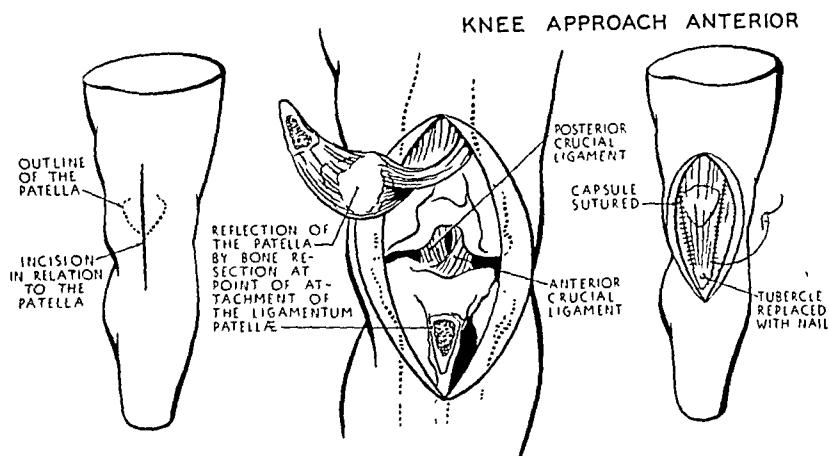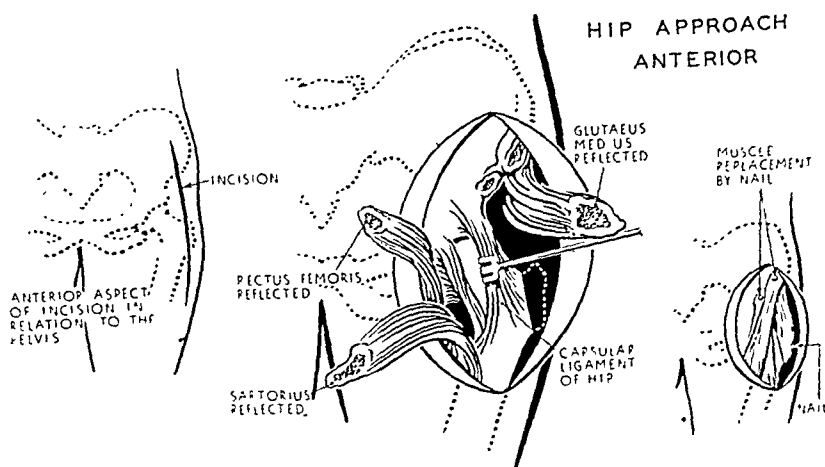LIGAMENT
OF HIP

NAIL

FIG. 3. Arthrotomy of the hip.

These approaches have been used with satisfaction. Exposure is facilitated, wound healing is prompt, and the scar is freely movable and not subject to pressure irritation. The latter factor was noticed particularly in four ankle arthrotomies. One knee incision out of nine showed some separation of the skin over the patellar tendon, possibly from too tight suture and insufficient compression bandage; and one adult traumatic fracture dislocation of the hip out of seven arthrotomies showed the development of myositis ossificans in the gluteal group, probably from the type of injury.

SUMMARY

Surgical approach to the major joints of the lower extremity can be simplified and facilitated by (1) placement of skin incisions so that maximum subcutaneous tissue flexibility is assured, and (2) resection of the bone attachments of tendons and ligaments.

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        IN cases of purulent arthritis of the ankle-joint there is often a sympathetic effusion into the tendon sheaths. It is possible that suppurative tenosynovitis may be confused with purulent arthritis, but as the former condition is likely to be confined to one set of the synovial tendon sheaths, the differential diagnosis is not usually difficult.

        From "Surgery of Modern Warfare" edited by Hamilton Bailey (The Williams & Wilkins Company).

LOCALIZED BACK PAIN

SEPARATION OF FIBERS OF POSTERIOR LAYER OF LUMBODORSAL FASCIA WITH HERNIATION OF THE SACROSPINALIS MUSCLE AS A CAUSE

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PERSISTENT localized pain in the soft tissues of the back following a wrenching type of injury often presents problems of diagnosis and too frequently responds poorly to the usual methods of treatment. The possibility that such pain may be due to separation of the fibers of the posterior layer of the lumbodorsal fascia is · apparently either an unrecognized or unconsidered entity, since available textbooks fail to mention the condition or to include it in the differential diagnosis of back pain. Search of the literature since 1933 has been unsuccessful in yielding information on this subject.

CASE REPORT

A twenty-four year old white, male soldier was squatting on the ground lifting a 50 caliber machine gun above his head to its place beneath the wing of a fighter aeroplane. Losing his balance but maintaining his grip on the gun, the heavy weight wrenched him backward and to his left, and at the same time he felt a "tearing" pain in the right lumbar region. He experienced considerable pain in his back on trying to straighten up. At the Base Dispensary in Africa, the back was x-rayed and strapped with adhesive plaster. For two weeks he was unable to work and spent most of the time in bed. He obtained no relief from baking and massage, and stated that an "air" injection was given beneath the fascia without benefit. Gradually the pain improved to the extent that he was able to carry on with light work, and eventually he became an aerial gunner, completing a tour of combat duty overseas. For eighteen months, however, he had a localized area of tenderness which became painful on straightening up after forward bending, on attempted lifting, and on prolonged standing or sitting.

The patient was admitted to this hospital primarily for the treatment of operational fatigue, the result of his combat tour. Surgical consultation was requested because of his complaints of back pain, at which time examination revealed an area of tenderness approximately 4 cm. in diameter over the right sacrospinalis muscle at the level of the third lumbar vertebra. Even slight forward bending caused pain. With the patient standing in a cross light, a small, but definite, bulge was noticed over the painful spot and this was exaggerated by coughing or starting to bend forward. An hiatus in the fascia could not be felt on careful palpation. Infiltration of the tender area with 5 cc. of 1 per cent procaine hydrochloride down to and including the posterior layer of the lumbodorsal fascia resulted in complete temporary relief of symptoms and full motion of the back without pain. This was repeated on two other occasions at five-day intervals, each time with temporary relief. Infra-red baking followed by massage gave no relief of discomfort.

Because of the evidence of a muscle hernia, surgical exploration of the area was performed. Using local infiltration anesthesia of 1 per cent procaine hydrochloride, a 5 cm. transverse incision was made directly over the bulge and carried down to the fascia where an elliptical split of the fascia approximately 1 by 4 cm. was at once apparent, the gap being thinly bridged with loose areolar tissue. The underlying sacrospinalis muscle was normal in appearance and to palpation. Except for the split, the fascia appeared strong and otherwise normal. After freeing the edges of the defect to enable easy approximation, the fascia was sutured with small interrupted sutures of No. 60 cotton, taking care that all the strain was not placed on the fascial strands immediately adjoining the margins. Skin and subcutaneous tissues were approximated with interrupted vertical mattress sutures of No. 60 cotton.

Healing occurred with a minimum amount of discomfort and early motion was encouraged.

Three weeks after operation the patient had full motion of the back without pain or local tenderness. He was under observation for three months, during which time he was active in vigorous athletic games and had no further discomfort.

COMMENT

This case is reported because it gives evidence that the existence of a split in the posterior layer of the lumbodorsal fascia will cause localized tenderness and pain on motions of the back, particularly those which would tend further to separate the fascial edges. Repair of the defect in this case gave relief of symptoms. The possibility of a longitudinal split in the posterior layer of the lumbodorsal fascia should be considered in the differential diagnosis of persistent localized back pain; and when there is clinical evidence of herniation of the muscle, surgical exploration of the area is indicated.

NEURALGIA is characterized by paroxysmal pain referred to the distribution of a nerve, without obvious organic cause. The condition is often difficult to distinguish from inflammation or irritation of a nerve.

From "Principles and Practice of Surgery" by W. Wayne Babcock (Lea & Febiger).

DEATHS FROM SURGICAL DISEASES OF THE BILIARY TRACT*

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IN attempting to analyze and evaluate statistics of this nature there are certain pertinent facts which must be given primary consideration. The first and foremost is the fact that a patient's recovery from a recurrent surgical disease without surgical interference is no particular credit to the type of therapy instituted, if the patient succumbs to the disease or its sequelae at a later date.

Unless a patient is followed throughout his entire life one is unable to ascertain whether his original recovery was a credit or debit to the attending physician in charge. It is quite simple for the internist to refer to his low mortality rate as far as diseases of the biliary tract are concerned; but he must be made to realize that unless the patient has been referred for surgery, so that a permanent cure can be achieved, he must shoulder the responsibility for at least a portion of the mortality resulting from the surgical treatment of the pathological condition; for with advancing age the risk becomes more serious, due to the fact that the patient is usually suffering from some concomitant malady, plus the results of prolonged or repeated attacks of biliary tract disease. Further, with the patient's recovery from repeated attacks he is much more apt to procrastinate in seeking permanent relief; and when his decision is finally made, he is already in an advanced state of the disease which makes him an easy prey for the complications encountered.

The physician who does not recommend surgery following the recovery of the patient from an acute attack and then points with pride to his low mortality is in the same position as the physician who recommends delayed therapy for appendicitis; and if the pathological process fails to subside refers the patient for surgery, thereby charging the mortality to the surgical treatment and keeping, as he thinks, his own skirts clean, pointing with pride to the zero mortality of the delayed type of therapy.

As will be shown later, recurrent attacks of biliary colic or the continued suffering from a lithogenic diathesis of the biliary tract, be it symptomatic or asymptomatic, is certain to produce pathological changes, if not acute, then of a chronic irreversible nature which will have serious consequences at a later date.

The fallacy that the so-called solitary or asymptomatic type of stone is a harmless intruder within the organism must also be corrected; for the solitary type of stone is probably responsible for more perforations of the gallbladder than any other type of stone, particularly if it is found in the ampullary portion of this viscus. If found in this location, it undoubtedly is wedged into Hartman's pouch and it is only a question of time when serious consequences will result. The gradual contraction of the pouch due to the presence of scar tissue secondary to the presence of a foreign body will gradually obstruct the cystic duct. The advancement of the process may lead to circulatory interference, starting a vicious cycle which may result in gangrene and perforation of the gallbladder unless surgical interference is interposed at the appropriate time.

Another fallacy is that the mere presence of stones in the biliary tract is no indication for surgery unless the patient has repeated acute attacks of biliary tract disease. The physician may stress the fact that the x-ray shows a normally functioning gallbladder; but the sooner we all realize that the x-ray simply determines whether or not a gallbladder concentrates the dye and it is not necessarily indicative of the presence or absence of active gallbladder disease, the sooner these patients will be brought to surgery with avoidance of some of the serious complications, thereby reducing the mortality.

TABLE I
TOTAL DEATHS, 398

	Number	Per Cent	Surgical			Non-surgical		
Common duct stone	133	33.41	62	15	58	71	17	89
Cancer of gallbladder or ducts	85	21.35	19	4	77	66	16	58
Subacute or chronic cholecystitis	54	13.57	48	12	06	6	1	50
Perforation	50	12.56	17	4	27	33	8	29
Acute cholecystitis	24	6.03	7	1	76	17	4	27
Infected hydrops	21	5.27	11	2	76	10	2	50
Intest. obstruction due to gallstone	9	2.26	4	1	01	5	1	25
Gangrene of gallbladder	6	1.50	3		75	3		75
Stricture of ducts	6	1.50	2		50	4	1	01
Cholecystoduodenal fistula	5	1.25	2		50	3		75
Pericholecystic abscess	3	.75	1		25	2		50
Bile peritonitis	1	.25	0	0		1		25
Primary cancer of liver	1	.25	0	0		1		25
	398		176	44	21	222	55	79
Acute pancreatitis	29		10			19		
Silent common duct stone	17							

Failure to concentrate the dye is indicative of gallbladder disease and represents the end result of the pathological process from an x-ray viewpoint. However, we must remember that the gallbladder disease has existed for some years previously before the x-ray non-function resulted.

Any lithogenic process of the biliary tract must be interrupted as soon as found in order to prevent the cirrhotic changes in the liver which definitely contribute to the surgical risk and undoubtedly is responsible for many of the deaths.

Gallstone or gallstones when present start on advancing pathological process which may or may not manifest itself with acute inflammatory or colicky attacks; but at any rate it is certain to assert its presence by producing irreversible pathological changes which no type of therapy can eradicate, and which as it advances calls forth newer and more serious complications until the organism is overwhelmed. The longer the process operates, the older the patient and the poorer the risk, the higher the mortality.

It can also be stated with certainty that barring surgical accidents the cause of death is approximately the same in the operated as in the non-operated patient. This probably is confirmation for the

TABLE II
MORTALITY RATE FOR AGE GROUPS

	0-9	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	100-	
Total	1	0	11	25	44	86	114	87	24	4	2	398
Male			5	4	8	33	53	40	15	2	1	161
Female	1	0	6	21	36	53	61	47	9	2	1	237

statement that the pathological process which leads to death of the patient following surgery may have had its incipiency sometime previously and had already started on its irreversible course at the time surgery was instituted.

In this discussion an analysis of 398 deaths is presented. This covers a ten-year period from both the medical and surgical services at the Los Angeles General Hospital. Twenty-nine deaths from acute pancreatitis and seventeen from silent common duct stone are also included in the discussion but not in the tabulation; for the timely death of the latter group from some other cause prevented them from dying from common duct obstruction or its sequelae. (Table I.)

As to the sexes approximately 60 per cent were female and 40 per cent male. This shows the male deaths all out of proportion to the female deaths, for the surgery performed at the Los Angeles General Hospital is approximately three and three-fourths females to one male. Table II.

The greatest incidence of death is in the sixty to sixty-nine year age group, which holds true for both male and female; but fifty-five per cent received no surgical treatment and accounted for approximately 18 per cent of the total mortality,
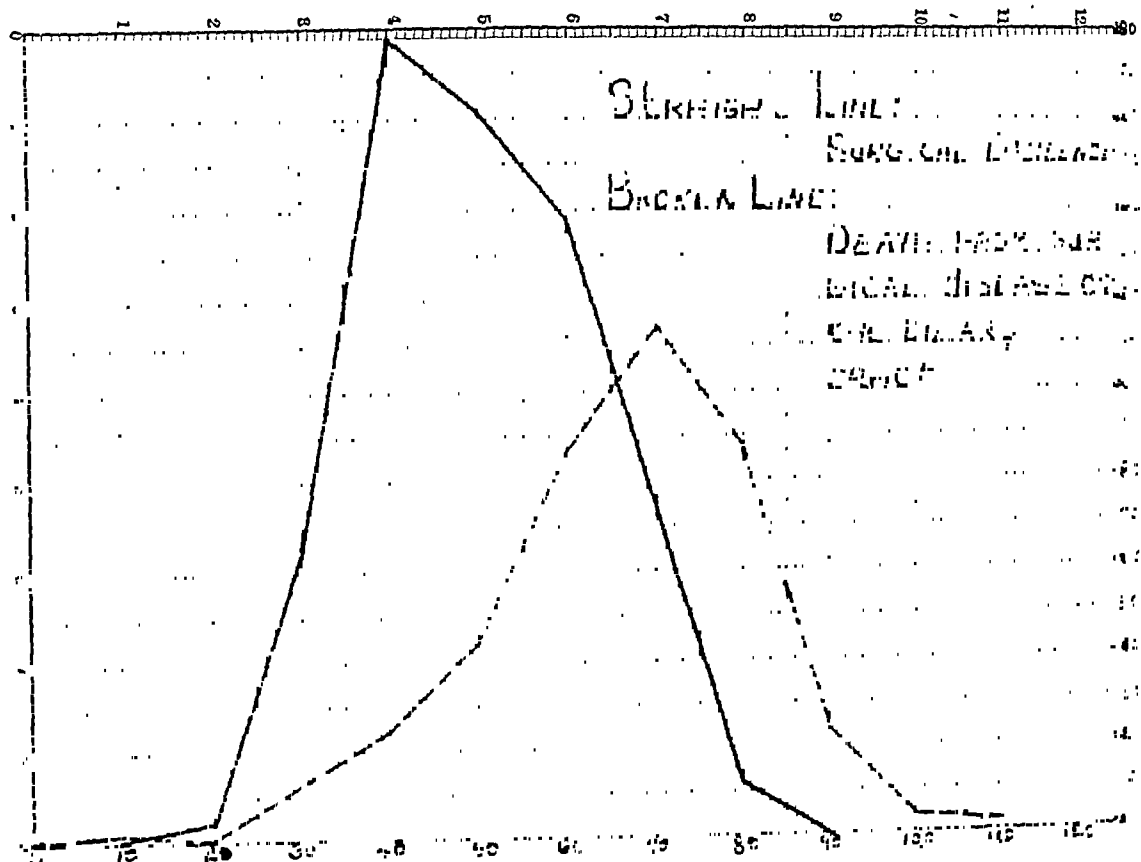

FIG. 1.

the greatest incidence for surgery upon the biliary tract is in the female age group thirty to thirty-nine and in the male forty to forty-nine year age group which definitely proves that the older the individual the greater the risk. (Fig. 1.) Over 90 per cent of the females operated upon at the Los Angeles General Hospital are below sixty years of age while less than 75 per cent of the males are below this age, which indicates that the male seeks surgical relief at a later date and the mortality is considerably higher compared with that of the female.

COMMON DUCT STONE

It was rather surprising to note that over one-third of the deaths were due to common duct stone or its sequelae, and of this number seventy-one or more than

while surgery accounted for but 15.58 per cent.

In further analysis we find that most of these patients have had repeated attacks of gallstone colic and for some reason or other surgery was deferred. This apparently is confirmation for the fact that the longer surgery is deferred the more apt the patient is to die from the sequelae of the common duct stone. Certainly, these stones are years in forming, particularly in growing to the size that they are capable of producing an ascending cholangitis or obstruction of the choledochus. Furthermore, a chronically inflamed gall-bladder whose walls are being replaced with scar tissue will gradually contract and tend to force stones of sufficient size into the ductal system so that they cannot readily pass the papilla of Vater

result of the chronic inflammatory condition of the gallbladder.

All of these patients were reasonably good risks and the pathological process was described as subacute or chronic and all patients operated upon were of the elective type. The operative group accounted for 12.31 per cent of all the deaths or approximately one in eight and the six non-operative patients represented .15 per cent of the total mortality. (Table vi.)

TABLE VI
CHRONIC AND SUBACUTE

	20–29	30–39	40–49	50–59	60–69	70–79	80–89	
Total..	3	8	7	14	12	5	..	
Male........	1	1	1	5	7	1	..	M 16
Female	2	7	6	9	5	4	..	F 33

As noted in Table vi the greatest female incidence is again in the fifty to fifty-nine year age group while the male is again ten years later. Females again predominated in a ratio of 2 to 1. This is probably the principle group in which the surgeon must practically shoulder the entire responsibility for the mortality.

Since the death rate, as previously reported,[1] in patients who are operated upon some weeks after the acute episode is much lower than that in those who are operated upon immediately after subsidence of the acute attack, it might be prudent to ′give this factor important consideration.

Better preoperative and postoperative care of the patient, the checking of the liver function particularly the Quick hippuric acid test may also be an aid in reducing the mortality. The specialization of services would undoubtedly be a tremendous factor. In, fact, this would be the ideal method, for all factors concerned could then be rigidly controlled.

Surgical accidents also play an important factor in the cause of death; consequently it behooves one to exercise utmost care in dissecting in the region of the ducts and vessels. You might wonder just how a ligature could be placed around the portal vein and hepatic artery, how the colon or duodenum can be perforated or why a patient should die of perforation of an appendiceal abscess which was discovered while attempting an incidental appendectomy following a cholecystectomy. No one should believe that these accidents befall the other man for I am sure that anyone doing biliary tract surgery may have had similar disheartening experiences. Dissection of the ′ gallbladder from the fundus to the duct, not ligating any unidentified structures would help to reduce ˙this mortality; for the accidents usually occur when the dissection is carried from the cystic duct to the fundus. If an incidental appendix is to be done, it should precede and not follow the cholecystectomy; stay in your own field; the ˙ fewer. the accessory procedures carried out the lower will be the mortality.

Four of the non-surgical patients were in the younger age group and two were of advanced years, namely, seventy to seventy-nine.

The differential diagnosis of those admitted with an acute attack was between acute pancreatitis, perforated peptic ulcer, acute appendicitis and coronary disease. The possibility of cardiac disease simulating an attack of acute biliary colic or visa versa must always be kept in mind.

This group represents the major group in which the surgeon can definitely contribute to the reduction of the mortality of the surgical disease of the biliary tract.

PERFORATION

Perforation accounted for approximately one death out of every eight. This figure is a little low because of the fact that in order to prevent reduplication of statistics all perforations which occurred in any of the sub-groups in this discussion are not duplicated here. However, a revision to include all perforations will bring the total to about 20 per cent or one in five. Perforation of course must be considered a complication and almost without exception is secondary to lithogenic disease of

MALIGNANCY

Over 20 per cent of the deaths from surgical diseases of the biliary tract were due to malignancy of the gallbladder or the ducts. While it is true that the profession throws up it hands in horror upon encountering malignancy of the biliary tract, nevertheless, there are certain relevant facts which must be considered. Autopsies disclosed the presence of calculi in forty-one of the sixty-eight deaths or 60.29 per cent which is approximately two-thirds. Many of these have an old history of biliary tract disease. In no other pathological lesion in this field is the need for early surgery a "must" if reduction of mortality is to be obtained. The removal of the gallbladder and its contained stones at an early date will positively prevent the later occurrence of a malignant lesion of the gallbladder.

The differential diagnosis is between that of carcinoma of the head of the pancreas, twenty-one patients, carcinoma of the stomach ten patients and gallbladder disease ten patients. This also stresses the importance of an exploratory laparotomy to establish the diagnosis, for frequently the so-called malignant lesion of the pancreas or stomach turns out to be a common duct stone. Five of these patients were admitted in coma which shows that malignancy of the biliary tract is one of the diseases which must be considered in the differential diagnosis of the comatose patient. This is also an indication of the state to which the disease had advanced before the patient sought hospitalization.

Seven were diagnosed malignancy of the biliary tract, four common duct stone, four cardiac disease, four obstructive jaundice, three cirrhosis of the liver, and two intestinal obstruction. (Table v.)

In the study of the age group, malignancy of the biliary tract did not occur in the male until after the age of fifty reaching its peak in the seventy to seventy-nine year age group. In the female malignancy was encountered in the early thirties and reached its peak in the sixty to sixty-nine year age group, ten years earlier than the male.

The total males were twenty-six and the females fifty-nine, a proportion of approximately two and one-fourth females to one male.

TABLE V
MALIGNANCY

	30–39	40–49	50–59	60–69	70–79	80–89	90–99	100–109	
Total...	2	5	18	32	22	5	..	1	
Male...	..	..	4	8	11	3	..	..	M26
Female.	2	5	14	24	11	2	1	..	F59

Fifty-seven or 67.06 per cent occurred below the age of seventy years, the youngest being a female aged thirty-four and the oldest a female aged 101. Approximately 25 per cent were subjected to surgery and needless to say nothing was accomplished with a possible exception that the diagnosis was established by biopsy. The age group also calls our attention to the fact that malignancy of the biliary tract may occur in the younger female age groups.

Up to the present time the fact has been stressed that in order to reduce the mortality from surgical disease of the biliary tract the physicians must be taught, particularly the internist, to refer the patients at an early date for surgical treatment, once the presence of stones has been established. This may sound as though the surgeon is passing the responsibility for his high mortality or is attempting to establish an alibi.

SUBACUTE AND CHRONIC

In the third group, namely, those in which the pathologist reported chronic or subacute inflammation we have a total of fifty-four patients which represent 13.57 per cent or approximately one-eighth of the deaths. Forty-eight were operated upon and six died without surgical interference, the cause of death being a direct

are entirely in keeping with the theoretical aspects. Only one of our patients has had a recurrence of ulcer symptoms and this

with recurrent and persistent hemorrhage, very obese and elderly patients should be treated along more conservative lines.
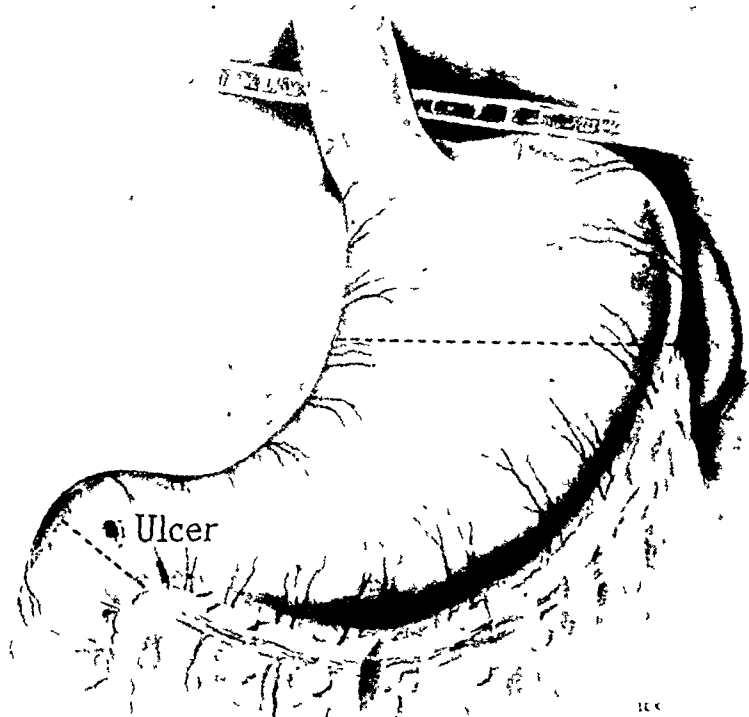

FIG. 1. The dotted lines indicate the approximate amount of stomach to be removed. The duodenum should be divided as close to the pylorus as possible to permit inversion of the pyloric stump without encroaching on the common duct. At times it may be desirable to divide the duodenum through the ulcer or even proximal to the ulcer.

case cleared up under medical care. Most patients find they can eat a meal of moderate size without discomfort; many of them eat large meals and very few follow the recommended several small meals daily. It is the boast of the majority that they can eat or drink anything they please. Many of our patients are merchant seaman and they appear to do well on board ship were dietary facilities are limited.

The operative risk is negligible in properly selected and carefully prepared subjects. Our seventy-five consecutive cases with no deaths certainly indicates that the operation can be done with reasonable safety.

In spite of the desirability of a subtotal resection, it is not always wise to submit a patient to this procedure. Debilitated individuals with chronic obstruction, those

In fact, a few of these may do as well or better with some more conservative procedure. I know of nothing more gratifying than the results of gastro-enterostomy is an old "burned out" ulcer at the pylorus with chronic obstruction and dilatation of the stomach, in a patient who is emaciated and literally starving to death. Gastro-enterostomy can be performed in a fraction of the time necessary for a resection of the stomach, through a small incision, with little trauma and no shock. The relief is almost immediate and is frequently permanent.

PREPARATION OF PATIENTS

Chronic ulcer patients frequently show vitamin deficiencies, anemia, low plasma protein levels, and poor nutritional states. It is desirable to have an excess of vitamins, especially B, and C administered for a

the biliary tract. It accounts for approximately one death out of five and many of these are due to the solitary type of stone which ordinarily is considered silent and harmless. Further analysis shows that but seventeen of these were submitted to surgery and thirty-three died from medical treatment or approximately 2 to 1. This certainly cannot offer much comfort to the internist when two-thirds of the patients die from a surgical disease without surgical interference. The group is almost equally divided, there being twenty-four males and twenty-six females.

When one considers the reality that the female is about four times as prone to develop this disease than the male, it emphasizes the fact that the mortality in the male is far greater than that in the female. (Table VII.)

TABLE VII
PERFORATION

	30–39	40–49	50–59	60–69	70–79	80–89	90–99	
Total	3	4	11	15	12	4	1	50
Male	1	1	5	8	5	4		24
Female	2	3	6	-	7		1	26
Surgical								
Total	1	3	5	4	4			17
Male	1	1	2	3	3			10
Female	0	2	3	1	1			7
Non-surgical								
Total	2	1	6	11	8	4	1	33
Male	0	0	3	5	2	4		14
Female	2	1	3	6	6	0	1	19

The comparision of these autopsy reports confirms the statement previously made that the complications resulting in the death of the patient secondary to a surgical procedure closely approximate the complications which result in death in medically treated patients. It is also quite likely, as previously stated, that the complications producing death after surgical procedures may have had their inception before the surgery was instituted.

This group also presents a forceful argument for early surgery; for through early surgery many of the grave complications which are responsible for the demise of the patient can be avoided. (Table VIII.)

TABLE VIII
CAUSE OF DEATH, 50

	Surgical		Non-surgical		Total
	P M	No P M	P M	No P M	
Hepatorenal	1				1
Peritonitis	3	2	11	2	18
Subphrenic abscess	2		6		8
Perforation	2	3	3	2	10
Atelectasis	1				1
Shock	1				1
Pericholecystic abscess		1			1
Abscess of abdominal wall		1			1
Liver abscess			3		3
Lung abscess			2		2
Cholangitis			1		1
Cardiac			2		2
Cirrhosis			1		1
Total	10	7	29	4	

ACUTE CHOLECYSTITIS

In this group we have twenty-four patients which represent 6.03 per cent of the total deaths. Seven of these were operated upon and seventeen treated medically. Of the surgical group four had cholecystostomy, two cholecystectomy and one was explored, the cause of the acute abdomen not being determined. Since a cholecystostomy is the simplest surgical procedure that can be performed in an acute condition of the gallbladder, the only reduction in mortality that can be obtained in this group is the performance of a cholecystostomy during the acute conditions in preference to cholecystectomy. However, here is a group of seventeen patients who died from acute cholecystitis without surgical interference. Nine of these had autopsies performed which verified the presence of acute cholecystis, and recorded secondarily, lung abscess three, hepatitis one, general peritonitis one, pulmonary tuberculosis one.

Of the eight deaths without autopsies the cause of death was recorded secondary to the acute cholecystitis, as, cardiac four, cholangitis two, diabetic coma one, and paralytic ileus one. Again, most of these

patients had a history of recurrent attacks of colic and the presence of stones was verified in a high percentage of patients. No one need be told that surgery in this group at the proper time would have spared many of these lives. Most of these patients were admitted acutely ill. In fact, their physical condition was of such gravity that surgery was deemed inadvisable in many instances.

The most important differential diseases were coronary disease, perforated viscus and pancreatitis.

EMPYEMA OF THE GALLBLADDER

The term, empyema, is a misnomer and should be discarded for infected hydrops, because the inflammation is in the wall of the gallbladder and, contrary to the term empyema, there usually is no pus within the gallbladder itself. It is also a known fact that this pathological condition is probably responsible for the greatest number of perforations of the gallbladder and it is usually the silent solitary stone which is responsible for the pathological process. It cannot be too strongly emphasized that this so-called asymptomatic or silent stone is responsible for the most vicious type of disease, particularly if it is in the ampullary portion of the gallbladder or in a Hartman's pouch; for it will positively sooner or later produce one of the most serious pathological conditions of the gallbladder.

There were twenty-one deaths in this group which accounted for 5.2⁻ per cent of the total. Eleven were operated upon and ten were treated medically. It is rather surprising to note that thirteen of these patients were males and eight females. (Table IX.)

Eleven of the thirteen males were sixty years or older and none below fifty years of age, while all the females were below seventy years of age. Practically one-half of the patients were in the sixty to sixty-nine year age group.

Almost all of these patients have an old history of gallbladder disease. The most important diseases considered in the differential diagnosis at the time of admittance was vascular disease and its sequelae.

Of the surgeries, three had a cholecystectomy and it is possible that the performance of a cholecystostomy may have spared some of these lives, the cause of death being pyemic abscess of the liver, liver death, and pulmonary embolism.

Of the eight cholecystostomies, five had postmortems performed with the cause of death being recorded as bronchopneumonia two, general peritonitis one, acute hepatitis one, empyema one.

In the three without a postmortem the cause of death was recorded as hepatic insufficiency, cholangitis and empyema.

Ten of these patients had no surgery and there were eight postmortem examinations. The recorded cause of death besides infected hydrops being multiple myeloma one, pulmonary edema one, hypertensive heart disease one, cholangitis two, portal cirrhosis two, bronchopneumonia one, abscess of the greater omentum one.

In the two without a postmortem examination the cause of death was recorded as chronic endocarditis and multiple liver abscess.

In one cholecystectomy stones were still found in the cystic duct and in one cholecystotomy stones were still found in the gallbladder.

Of the seventeen postmortem examinations the presence of stones was verified eleven times. Most of these patients had recurrent attacks of biliary colic and had an old history of biliary tract disease. Surgery before the advent of the acute biliary process undoubtedly would have saved some of these patients.

INTESTINAL OBSTRUCTION DUE TO GALLSTONE

In the ordinary differential diagnosis of an acute condition of the abdomen intestinal obstruction due to gallstones is not given sufficient consideration. In this group we have a total of nine patients which represent 2.26 per cent of the total deaths. This group should naturally be combined with the internal biliary fistula but in view of the fact that it presents an unusual complication it will be considered separately. Five of these patients were operated upon and four were not, which again emphasizes the fact that too many patients are dying from surgical diseases of the biliary tract without the proper treatment. All these patients were over sixty years of age there being three males and six females. Although the diagnosis of intestinal obstruction was frequently correctly established the etiological factor, however, was not always correctly stated. A review of the histories, however, suggests that localized pain in the right upper quadrant in association with jaundice of a subsiding nature, with positive findings of intestinal obstruction should place one on guard as to the possibility of the obstruction being due to a gallstone. Since most of these patients had an old history of biliary tract disease it is quite likely that early surgery would prevent or reduce the number of deaths due to this complication.

PERICHOLECYSTIC ABSCESS

Pericholecystic abscess probably rightfully also belongs in the perforative group. However, in view of the fact that two schools of thought prevail, namely, the one that believes abscess is due to perforation and the other that the infection can pass through the wall of the gallbladder producing an abscess without perforation, it was thought best to consider this as a separate group. There were but three patients one of whom was moribund upon admittance, two being operated upon and expiring from surgical collapse and pericholecystic abscess.

GANGRENE

Rightfully gangrene of the gallbladder should also be considered with perforation for it is simply the pre-perforative state, the patient being operated upon or dying before the perforation takes place. Six patients were in this group which accounted for approximately 1.5 per cent of the mortality.

There were five males and one female, three being operated upon and three being treated medically. Again, one-half the patients did not receive the treatment to which they were entitled. The patients in this group, however, were very ill upon admittance and only early surgery would have benefitted any of them.

STRICTURE

The last group of any consequence consists of six patients who lost their lives because of a surgical accident, namely, a stricture secondary to surgery of the biliary tract. Although but two of these patients were reoperated upon the entire group of course must be charged to surgery even though four did not receive surgical treatment at this time.

As previously stated most accidents occur in removing the gallbladder from the duct to the fundus, and it is quite likely that had this procedure been reversed some of these patients may have had their lives spared.

In this group cirrhosis played an important part in the production of death.

In completing this summary there is one patient who died of a primary carcinoma of the liver and one patient who died from a bile peritonitis; the source of the bile leakage could not be ascertained even at autopsy.

ACUTE PANCREATITIS

Since the most accepted and plausible hypothesis regarding acute pancreatitis

is that it is secondary to disease of the biliary tract and since disease of the biliary tract as related to pancreatic disease is primarily one of gallstones, the physician who does not recommend surgery for gallstones must assume the major portion of the mortality from this disease. One must frankly confess that surgery probably does not have much to offer during the acute episode but certainly the removal of a gallbladder filled with stones would be the most prophylactic step which could be taken.

There were twenty-nine patients in this group, eleven being operated upon and eighteen being given medical treatment. There were twenty-four postmortem examinations in which stones were found in twenty-two instances, acute cholecystitis one, and acute yellow atrophy of the liver one. This appears to be conclusive proof that acute pancreatitis is secondary to disease of the biliary tract particularly that of the lithogenic variety. Many of these patients also had previous repeated attacks of biliary colic or history suggestive of cholecystitis.

In closing it is needless to say that all the patients in this series presented some degree of cirrhosis of the liver, the amount being directly dependent upon the type of a pathological lesion present and the time of its duration.

CONCLUSION

The physician who does not recommend surgery for biliary calculi regardless of type is definitely responsible for a portion of the surgical mortality.

The surgeon must attempt to improve the patient's condition before surgery and be careful of the technic which he uses.

He must: (1) Use the cholecystostomy more frequently; (2) explore more common ducts and be more thorough in his exploration; (3) explore the duct before doing the contemplated cholecystectomy so the gallbladder can be used for an anastomotic procedure if necessary; (4) avoid injuries to the ducts, vessels and hollow visera; (5) remove all stones in doing a cholecystostomy; (6) perform more liver function tests to attempt to ascertain, if possible, the state of the liver; and (7) administer the best in postoperative care, remembering that the early use of blood or plasma is of far greater value than its administration to a moribund patient.

REFERENCE

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SUBTOTAL GASTRECTOMY IN THE TREATMENT OF ULCER*

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THE surgical treatment of gastric and duodenal ulcer has undergone a gradual change in this country during the past decade. Subtotal gastrectomy is now an accepted surgical procedure but this was not true ten years ago. Certain European surgeons have for many years advocated gastric resection in the treatment of ulcer. Its slow adoption here has been due to skepticism of the end results, and to the relatively high mortality observed in some clinics. Experience has proved that the results are satisfactory and that the mortality can be kept on a par with the more conservative operative procedures. In our series of seventy-five consecutive cases of intractable ulcer treated by subtotal resection, we have had no deaths.

The absence of mortality has been due to a number of factors. There has been close cooperation between the medical and surgical services in selecting patients for resection. Every possible effort has been made to have patients in good condition at the time of operation. Where chronic obstruction, persistent hemorrhage or other associated disease has interfered with such preparation, we have been content with some more conservative method of treatment. Selection of cases, preoperative preparation and postoperative care are considered equally important with the technical procedure involved.

INDICATIONS FOR OPERATION

It is generally conceded that duodenal ulcer which does not heal and remain healed under medical care should be treated surgically.

Ulcer complicated by chronic perfora-tion, obstruction, massive or recurrent hemorrhage should be treated surgically. Gastric ulcer should have the benefit of early operation when it cannot be differentiated from cancer. It may be justifiable at times to try a short period of conservative treatment in gastric ulcer but if long periods of trial therapy are carried out, the patient may lose his golden opportunity for cure of a malignant lesion. Certainly it is very difficult to tell roentgenologically whether a lesion in the stomach is ulcer or cancer, and if an error is made it should be in favor of the more serious lesion.

CHOICE OF OPERATION

On the basis of our experience and that of others, subtotal gastrectomy is the operation of choice in practically all ulcer cases requiring surgery. Theoretically, the operation appears to be based on sound physiological principles. While the etiology of ulcer is not definitely known, we do know that it is usually associated with a high gastric acidity. This acidity can be reduced by removing most of the acid-bearing portion of the stomach. The most vulnerable portions of the stomach and duodenum are also removed or side-tracked. Following operation the alkaline biliary and duodenal secretions are re-gurgitated into the stomach. The stomach empties rapidly and the stoma and upper jejunum are constantly bathed in an alkaline medium. This combination of factors produces a situation in which the acidity is lowered or neutralized and the gastric phase of digestion is much shortened.

From a practical standpoint, the results

MARCH FRACTURES OF THE FOOT

CARE AND MANAGEMENT OF 692 PATIENTS

Colonel Abraham Bernstein,

Lieut. Col. Marvin A. Childers,   Major Kermit W. Fox,

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IN reviewing the literature on march fracture, we find that many authors consider this a rare clinical entity. This has not been our experience since during the past fourteen months at Camp Wolters, Texas, we have seen 692 cases of march fracture.

Three hundred seven cases have already been reported.[1] We would now like to report an additional 692 cases. All these cases have had the diagnosis substantiated by positive x-ray evidence, and none of these soldiers gave a history of sudden or violent injury.

Why is it that here we see a larger number of march fractures than at other Infantry Replacement Training Centers? Are·we march fracture conscious at this post, or do we have personnel who recognize this entity and diagnose it as such? Is this condition being called something else at other Replacement Training Centers? Truthfully, at times we wonder. It is true we are fortunate at this post in having well trained chiropodists who cooperate with the various area surgeons in a very singular manner.

Because of the large number of cases seen, we believe this additional report should be made. It is believed that this report should be made, too, in order to show the number of training hours saved during the past fourteen months. Out of our 692 cases, forty-five soldiers were excused from certain portions of their training cycle for a period of six to eight weeks, until their march fracture healed; thirteen other patients were hospitalized. We thus had a total number of fifty-eight soldiers who were hospitalized or excused from certain portions of their training cycle and had to start a new training cycle. Out of this group one trainee received a medical discharge, but this was for an injured right knee and not for his march fracture. The remaining fifty-seven trainees eventually finished their training cycle and were qualified for overseas duty. Six hundred thirty-four soldiers were given ambulatory treatment and completed their entire.training cycle. On the basis of fifty-six hours' duty per week, and a minimum period of six weeks usually required for the healing of a march fracture, it is believed that every man treated by our method saved 336 training hours, thus we saved the grand sum of 213,024 training hours during the past fourteen months.. The object of our treatment is essentially to protect the fracture so that it does not displace, to produce as little stiffness and bone atrophy as possible, and to save training hours.

ETIOLOGY AND PATHOGENESIS

Ever since Breithaupt[15] reported the first series of march fractures in 1855, many theories and concepts of etiology and pathogenesis[2–13] have evolved. It is not the purpose of this paper to substantiate or disprove any of these causes, but since this is the largest series thus far reported, it should be valuable to clarify further the controversial issue of whether a relatively shortened first metatarsal is instrumental in effecting this type of fracture. The relative lengths of the first four metatarsals was therefore established. In accomplishing this, an arbitrary base line was constructed from the center

week or two prior to operation. Three hundred mg. of cevitamic acid and 10 mg. of thiamine chloride are administered

by Lemmon.[1] This is sometimes reinforced with local and splanchnic block, using ½ per cent novocain solution. A degree
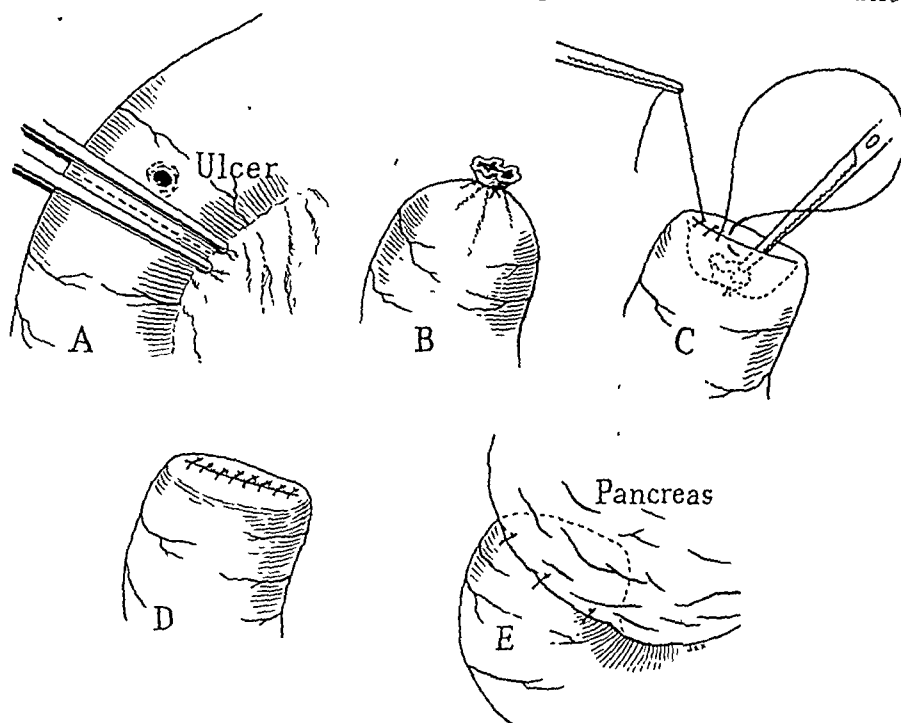

FIG. 2. Method of handling the duodenal stump. A, the duodenum is crushed and divided between simple hemostatic forceps; B, a ligature is placed on the crushed duodenal stump; C; the stump is inverted into the pylorus and a running suture of fine catgut is used to maintain the inversion; D, the suture line is reinforced with interrupted sutures of fine silk; E, the stump is firmly anchored against or slightly under the head of the pancreas with several silk sutures.

daily by the parenteral route. The plasma protein should be 7 Gm. per cent or over and the red blood count above 4 million. Diet and repeated blood and plasma transfusions may be necessary to achieve these levels. High protein feedings are desirable where possible. Alkalies should be omitted for several days prior to operation to allow the stomach to regain its normal acidity. If no obstruction is present,. I can see nothing to be gained by preoperative washing of the stomach and we have practically abandoned it. It is possible that preoperative washing of the stomach may actually increase rather than decrease the possibilities for contamination and postoperative infection.

TECHNIC

Fractional spinal anesthesia with metycalne is used after the method developed

of relaxation is achieved which is rarely seen with general anesthesia. Five per cent glucose in normal saline is started intravenously immediately prior to operation and is allowed to run in slowly. To this is added a blood transfusion apparatus and 500 cc. or more of whole blood is given during the operation. An attempt is made to replace the entire amount of blood lost during operation.

A midline incision is used. After brief exploration of the abdomen and especially the ulcer area, the decision is made as to what procedure is indicated. If resection is decided upon, a slight modification of the Hofmeister technic is usually employed. Points of especial interest are the common bile duct and the middle colic artery. These must be exposed and at all times their position known. The mesentery of the stomach and duodenum

FIG. 3. The distal two-thirds of the stomach has now been removed and the first portion of the jejunum has been brought up anterior to the colon so as to show its relationship to the new stoma.

is freed close to their borders and all vessels carefully ligated. The duodenum is divided between hemostats. The stump is ligated like an ordinary appendix stump, then inverted, and finally reinforced with interrupted sutures of fine silk. (Fig. 1.) The stomach is divided at the junction of the middle and upper third. (Fig. 2.) The first portion of the jejunum is brought up anterior to the transverse colon and placed against the gastric stump in such a manner that it lies naturally, without tension and without kinking. About one-half of the width of the stomach is used in the anastomosis; the remainder is closed. The stoma is placed toward the greater curvature of the stomach. (Fig. 3.) No. 0 chromic gut is used in the anastomosis and this is reinforced with fine silk. The arms of the jejunum lateral to the anastomosis are anchored with silk so as to prevent a downward drag at the stoma site. (Fig. 4.) Four Gm. of sulfanilamide powder are sprinkled in the peritoneal cavity and the abdomen is closed in layers without drainage.

Throughout the operation the tissues are handled gently and the exposed bowel is kept covered with warm saline packs. There is practically no shock and the patient's first request on return to bed is usually a cigarette.

POSTOPERATIVE CARE

Gastric suction is started as soon as the patient is returned from the operating room, using a small Levine tube passed through the nostril. Tap water is given freely if the suction is functioning well.

Fluids by vein are given in sufficient quantity to maintain fluid and electrolyte balance. This requires an average of 3,000 cc. daily as long as gastric suction is maintained. Approximately 2,000 cc. of this is given in the form of 5 per cent glucose in normal saline. This is equivalent to 17 Gm. of sodium chloride and approximates the amount lost in gastric secretion, urine, and perspiration. About 1,000 cc. is given as plasma or plasma and whole blood.

Clear liquids are started in forty-eight hours with the gastric tube clamped off. If the stomach appears to be emptying well, the tube is then removed. Milk, custards, egg nog and cereals are rapidly added and on the fifth day or thereabouts a fairly substantial diet is given. If distention occurs, the tube is immediately re-inserted.

There have been no eviscerations and no gastric fistulas and primary healing of the abdominal wound has been the rule.

SUMMARY

1. The surgical treatment of gastric and duodenal ulcer is briefly reviewed with particular attention to subtotal gastric resection as the method of choice.

2. This review is based on seventy-five consecutive cases in which the patients were treated by subtotal resection with no deaths.

3. The postoperative results have been good. There has been one doubtful recurrence of ulcer which was promptly relieved by medical therapy. Almost without exception the patients have returned to their usual occupations and are leading normal lives.

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metatarsal bone was an outstanding factor in the cause of march fracture.

Table II shows the time interval of the training cycle when the fracture occurred.

the foot, and (5) crepitus. This is exceedingly rare.

The earliest cases which are recognized by x-ray as march fracture[11,14] are those

FIG. 2. Slight thickening of the periosteum along medical aspect of the middle third of the third metatarsal bone.

Figure 1 shows that most of the march fractures occurred when the training "got tough."

DIAGNOSIS

The one constant, early, subjective complaint is pain in varying intensity in the forefoot.

The clinical objective findings stated in the approximate order of diagnostic value are: (1) Point tenderness over the dorsum of the involved metatarsal; (2) pain in the region of the involved metatarsal upon manipulation of the corresponding toe. Traction and dorsoflexion of the toe seem to produce pain more readily than any other form of movement. (3) Swelling of various degrees localized on the dorsum of the foot with the point of maximum swelling centered over the involved metatarsal; (4) limp on the part of the patient, due to pain on weight bearing surface of

in which slight thickening of the periosteum is noted, usually along the medical aspect of the distal and middle thirds of the metatarsal. (Fig. 2.) Upon subsequent examination, larger amounts of callus formation was noted on either side of the shaft of the bone at the site of injury. (Fig. 3.) In a portion of these cases, a definite fracture line is not seen. There have been numerous instances in which the incomplete oblique fracture has been seen with a small amount of callus formation. Films taken on subsequent dates showed complete healing, with a small amount of callus formation. These cases were treated early with immobilization by using the march bar. (Fig. 8.) However, other cases of oblique march fracture (Fig. 4) have gone on to communition type of fracture, with 2 or 3 mm. shortening of the shaft, with a large amount of callus formation.

of the articulating portion of the head of the second metatarsal to the junction of the proximal and medial borders of the
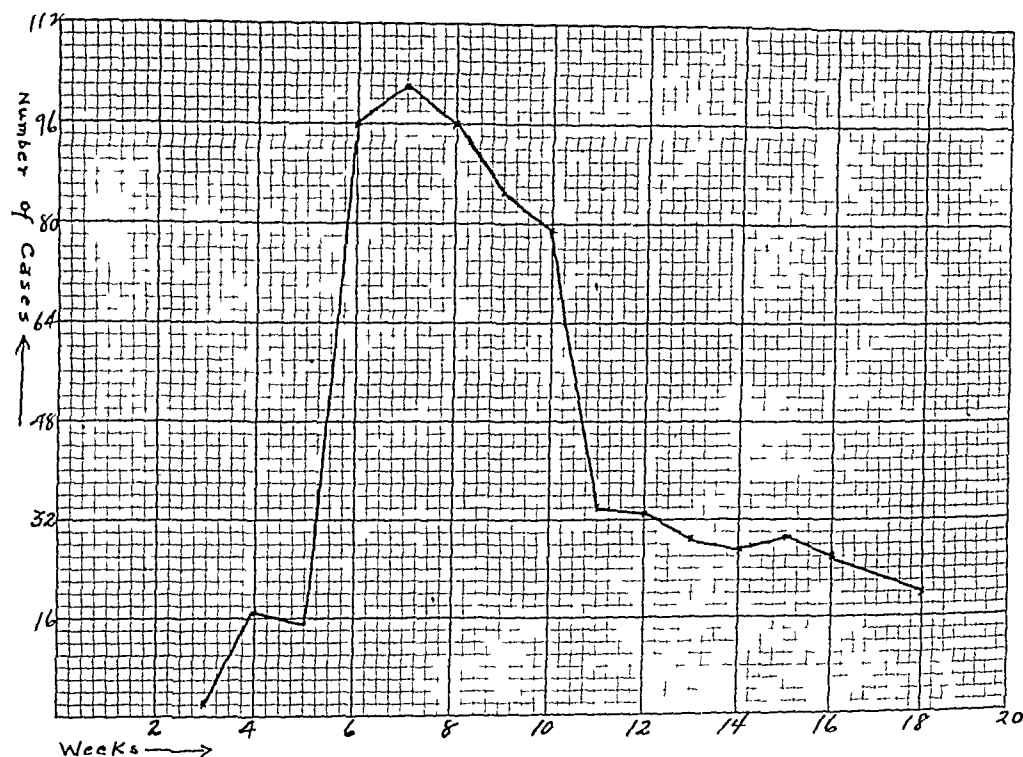

FIG. 1. Time interval of cycle when march fracture occurred.

base of the same bone. This was drawn on a true dorsoplantar view x-ray. By using this established base line as a common axis and with the aid of a transparent T-square, the difference in length of the first four metatarsals was measured in relation to that of the second. Assigning, therefore, a value of "o" to the second metatarsal, the findings (expressed in millimeters) in a series of 100 normal feet and 692 with march fractures are shown in Table 1.

From the findings shown in Table 1 it appears that the relative lengths of the first four metatarsals in 100 normal feet, as compared to the first four metatarsals of the 692 having had march fractures, are practically the same. It is questionable, therefore, whether a relatively shortened first metatarsal plays any part in causing march fractures. We cannot agree with Dodd[7] who believes that a short first

TABLE I

	1st M/T	2d M/T	3d M/T	4th M/T
100 normal feet	−5 5	o	−3 06	−11 17
692 feet with march fracture	−4 4	o	−3 8	−9 0

Note: Plus values represent lengths greater than that of second metatarsal. Minus values represent lengths less than that of second metatarsal.

TABLE II
TIME INTERVAL OF CYCLE WHEN MARCH FRACTURE OCCURRED

Week	Cases
3d	2
4th	17
5th	15
6th	96
7th	102
8th	96
9th	85
10th	79
11th	34
12th	33
13th	29
14th	27
15th	29
16th	26
17th	22
	—
	692

Table III shows the metatarsal bones involved.

Our six hundred and ninety-two cases

the right foot than in the left, and that any one of the metatarsals could be involved.

FIG. 5. A, large amount of callus formation of the middle third of the third right metatarsal bone showing communition and shortening. Same case as shown in Figure 4. B, oblique view showing large amount of callus formation middle third of third right metatarsal bone, showing communition and shortening. Same case as shown in Figure 4.

showed 724 march fractures. It is noted that the fracture occurred more often in

TABLE III
FRACTURED METATARSALS

	Right	Left
1st	2	0
2d	181	138
3d	224	150
4th	16	9
5th	3	1
Total, 724	426	298

The following conditions should be considered in the differential diagnosis of march fractures: (1) Other traumatic lesions: (a) contusions, (b) foot strain, including metatarsalgia, (c) traumatic arthritis, (d) true traumatic fracture; (2) inflammatory lesions: (a) cellulitis, (b) skin infections, such as dermatophytoses, (c) osteomyelitis, (d) tenosynovitis, (e) various types of arthrides; (3) Freiberg's infraction; (4) syphilis; (5) new growths: (a) osteoma, (b) sarcoma.

TABLE II

Author		Reference	Sex	Age	Source of Diagnosis	Classification and Type	Tumor
Chiari	1888	23, 30, 45, 52	f	44	autopsy	lateral, complete, ii	pedunculated adenomatous polyps
Collier	1896	23, 30, 52	m	21	operation & autopsy	central, complete, ii	polyposis of stomach, duodenum, and jejunum
Thompson	1897	23, 52	f	75	autopsy	central, complete, ii	fibroadenoma
Miodowski	1903	14, 30				merely lateral indentation, no invagination	
Lotsch	1911	31	f	58	autopsy	central, complete, g-d-j*	myoma
Myer	1913	33	m		operation & autopsy	central, partial, ia	polyposis
Wade	1913	53	f	48	operation	lateral, complete, g-d-j	fibromyoma
Baylac et Dieulafé.	1918	3	f	43	operation	central, partial, gastro-gastric	fibromyoma
Doebler	1918	14	m	48	autopsy	central, complete, g-d-j double (see text)	myoma, mucosal polyps
Fabricus & Møller	1918	18	f	66	autopsy	lateral, complete, ii	adenoma
Eusterman & Sentry	1922	17, 23, 30	f	65	operation	lateral, complete, iii	fibromyoma
			f	22	operation	central, partial, ia	hemangioma
Shuman & Cruikshank.	1923	48	f	35	autopsy	central, complete, g-d-j double (see text)	polyp, taeniae
Matas	1923	32	m	55	operation	central, partial, ia	adenoma
Barnett	1925	2	m	54	operation	lateral, complete, g-d-j	myoma
Eliason & Wright	1925	16	m	56	operation	central, partial, ia	mucosal prolapse
Mouat	1925	23, 30, 52	f	12	operation	central, partial, i with perforation of duodenum	adenomatous polyp
Eliason, Pendergrass & Wright, 1926; see Pendergrass, 1930.							
Vulliet	1927	52	f	51	operation	lateral, complete, g-d-j	fibroadenoma
Guleke	1927	23, 30, 52	m	32	operation	lateral, complete, ia	adenoma
Schmieden & Westhues	1927	45	f	78	operation	central, complete, g-d-j	adenomatous polyps
Henschen	1927	23	f	51	operation	central, complete, g-d-j	mucosal papilloma
Bogoras	1930	30, 45	f	42	operation	central, complete, ii	sarcoma
Pendergrass	1930	39	various		x-ray	herniating, prolapsing, and ball-valve types	papillomas, adenomas, fibromas, polyps; mucosal hypertrophy
Iceton, Poale, Terbutt	1931	24	f	47	autopsy	central, complete, i	neurinoma
Robson & Moynihan		24				central, complete, ia	adenoma
Saupe	1932	43	m	45	x-ray, operation	central, partial, ia	polyp
			f	34	x-ray, operation	lateral, complete, i	papilloma
Lonnerblad	1933	30	f	45	x-ray, operation	central, complete, i	fibroadenoma
Pansdorf & Determan	1933	38	m	72	operation	lateral, complete, iii	polyposis
Moura, de Brito, Lopes.	1934	36	m	54	operation	lateral, complete, ii	fibroadenoma
			m	50	operation	lateral, incomplete, ia	polyp
Galifi	1938	22	m	56	x-ray	central, partial, ia, re-cedivating, transitory	no surgery nor autopsy
Fiori	1939	20	m	67	operation	lateral, partial, g-d-j	fibroadenoma
V. Meissner	1939	50	f	77	autopsy	central, complete, iii	polyp
Zdansky	1939	54	f	57	x-ray, operation	central, complete, iv	polyp
			f	59	x-ray	central, complete, with external mechanism	gall stones
			m	73	x-ray	central, complete with external mechanism	polyp & carcinoma
Bignami	1939	6	f	69	x-ray	central, complete, ii	no surgery nor autopsy
V. Hoyningen-Huene	1940	51	f	16	operation	lateral, complete, iv	polyp
Schmitt	1940	46	f	56	x-ray, operation	central, complete, i	polyp (? malig. degen.)
Rothe	1941	41	m	59	x-ray, operation	central, complete, i	fibroadenoma
Daza & Zuniga	1942	13	f	43	x-ray, gastroscopy	central, partial, ia	lipoma
Eckhoff . ..	1943	15	m	29	operation	lateral, partial, iii	mucosal hypertrophy
Weinberg & Raider	1943	58	m	75	x-ray, autopsy	Central, partial, ia	oscillating polyp
Norgore & Shuler	1945	57	f, m	61, 42	operation	central, partial, Ia	extrusion of mucosa

* g-d-j = Gastro-duoden-jejunal.

Thirdly, the severity of the invagination may be graded I to IV, depending upon the anatomic division of the duodenum reached by the intussusception. Grades I, II, III, IV successively correspond to the apex of the invaginatum having descended to the superior, descending, inferior horizontal, or ascending portion of the duodenum. Simpler instances in which the gastric tumor or the stomach mucosa (décollement) have entered the protopyloric (oral) portion of the duodenum have been called *prolapse, herniation, eventration* or *extrusion.* (Fig. 5.) Severe cases range through to the gastroduodenojejunal form.

Fourthly, Zdansky[54] Schmitt[46] amongst others, have described cases which heretofore have been called "retrograde invagination." Such a designation implies that the intussusception moved orally, e.g., opposite to the direction of peristalsis. Actually, in the recorded instances, the proximal portion *of the stomach was described as descending isoperistalically and gliding over a distal segment. The ensheathing portion of the bowel in these "retrograde"* cases was proximal (oral) and surrounded a distal portion of the bowel instead of *being contained within the latter. It is not that an invagination occurred.* The stomach had migrated forward and surrounded an adjacent section of the bowel. The direction was anterograde not retrograde. Accordingly, because the oral segment had come to lie outside of and around the aboral portion, it is suggested that this form be called *invagination with an external mechanism.* (Fig. 5.) This is in contrast to the conventional type which consists of an intussusception that arises proximal, descends, and comes to lie within an ensheathing (outer) segment of the bowel that normally is situated distally. In this more frequent form the intussusception displays an internal mechanism.

In summary, the varieties of gastroduodenal invagination can be classified as: (1) Complete or partial, (2) central or lateral, (3) invagination with an internal mechanism or invagination with an external mechanism, and (4) grade I, IA, II, III, or IV (IA: prolapse, herniation, eventration, extrusion).

In accordance with this nomenclature our own case would be one of a complete, central invagination with an internal mechanism and Grade IV. Referring to Table II, of all the instances featured in the literature *as gastroduodenal invagination,* actually only two others were of this type, nine were more severe, seven were of Grade II and four were of Grade III. The central type is more frequent than the lateral, the complete more common than the partial.

Symptomatology. To date a tumor formation has always been associated with gastroduodenal invagination. As a consequence, the symptoms in the outset are those of a benign tumor of the stomach. These are numerous and variable: pain in the epigastrium or around the umbilicus, nausea, vomiting, eructations, anorexia, fatigue, diarrhea, loss of flesh, and emaciation. Hemorrhage and melena are frequent, a tumor may at times be palpated. Or the whole course of the syndrome may simulate gallbladder disease even with recurrent jaundice, the latter being caused by the tumor or the invaginatum occluding the lumen of Vater's papilla. The symptoms and the diagnosis of a lipoma of the stomach are no different from that of a benign tumor.

Gastroduodenal intussusception in its early and recidivating forms will produce many of the listed symptoms. In the late phase the clinical picture is that of an acute intestinal obstruction from which it cannot be differentiated. Intervention is an emergency and will be dictated more by the indications for operation than the diagnosis established by laparotomy.

Rather characteristic is the ball-valve syndrome which has been described with certain forms (Grades I, IA, and II as enumerated). This syndrome is due to the sudden obstruction of the lumen of the pylorus by a prolapsed tumor, a herniation of hypertrophied gastric mucosa or
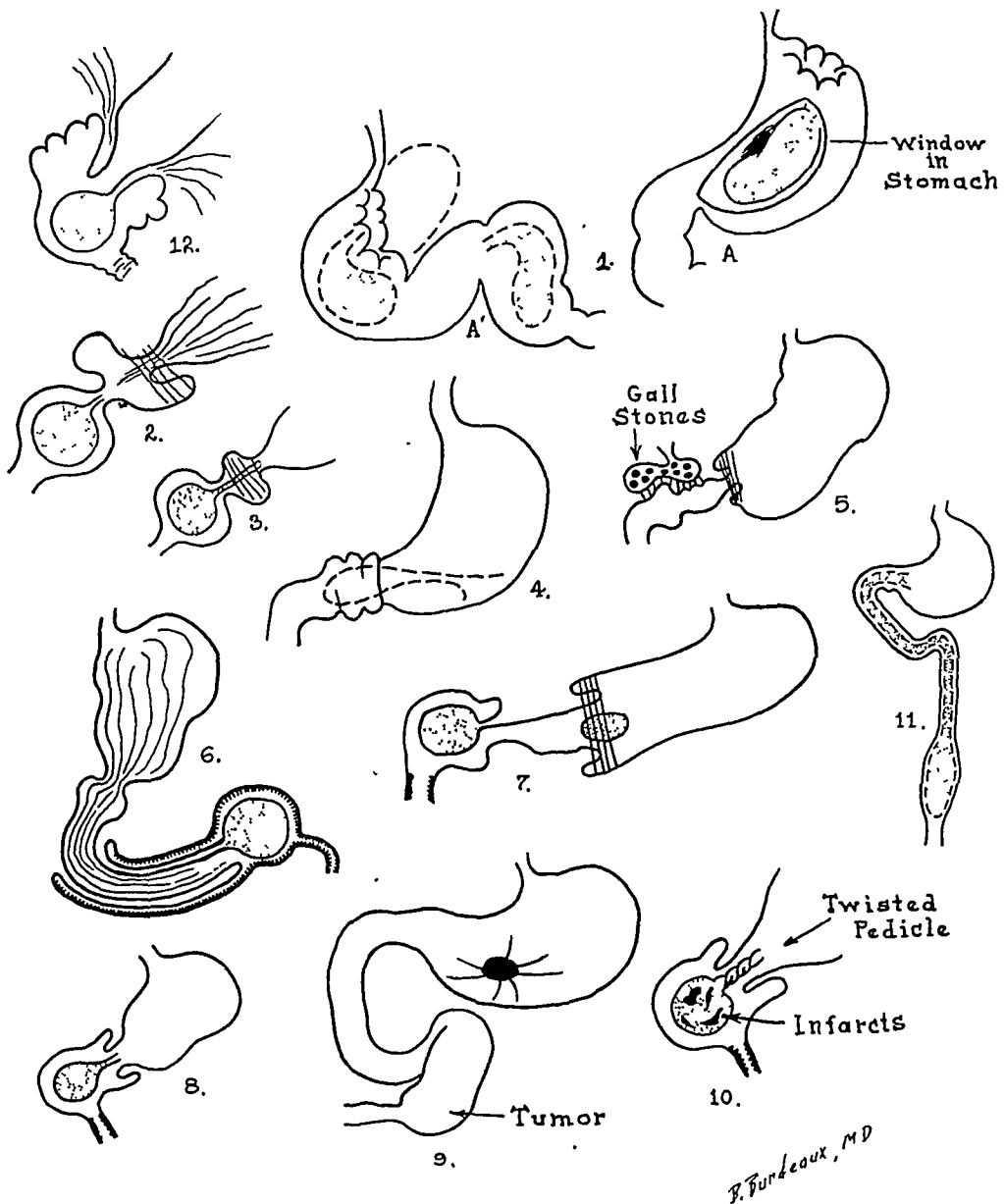
FIG. 5. A summary of features illustrating the gastroduodenal invagination: *Lateral type:* 1, showing the evolution and reaching the ligament of Treitz (Barnett); 9, with descent into the jejunum (Wade). In both, the entire thickness of the wall is involved (*complete*) and the stomach shows a funnel-shaped depression or umbilication of its surface (lateral). The axis of the intussusception is at an angle to that of the stomach. *Central type:* the whole circumference of a portion of the stomach is symmetrically pulled into a succeeding section of the bowel; the axis of the invagination is parallel to the long axis of the bowel. 4, 6, 8 and 12 represent different degrees of descent (Grades I–IV), 6 to the duodenojejunal flexure (Zdansky); *Partial Type:* only the juxta-luminal constituents of the stomach, the mucosa or the tumor, are involved. No. 11 shows a polyp that grew down into the jejunum; the outer surface of the stomach is uninvolved (Fiori). *Invagination with an external mechanism:* 5 and 7, the stomach glides isoperistaltically and ensheaths a distal segment of the duodenum instead of being contained within the latter (*internal mechanism;* 1, 4, 6). *Prolapse, herniation* of the tumor causing ball-valve syndrome is represented by 8. *Radiographic signs* (2, 3): converging axial and parallel transverse striations (Schmitt), the former due to streaks of barium within the mucosal folds in the lumen of the intussusceptum. The latter are due to the barium in the lumen of the intussuscipiens and lie external to the axial. No. 10 is the mechanism of spontaneous healing following torsion, self-amputation, and subsequent vomiting or defecation.

an early intussusception. The symptoms consist of: sudden and violent attacks of retching and vomiting accompanied by pain and flatulence. These are transitory, subside in due time but usually reappear. Between attacks the patient is comparatively well.

Radiology. Moore[35] set up criteria to facilitate the x-ray diagnosis of a benign tumor of the stomach. These comprise: (1) a filling defect that is circumscribed, punched-out in appearance and which is usually on the walls leaving the curvatures regular and pliant, (2) the rugae of the stomach are obliterated in the immediate area of the tumor but elsewhere they are more nearly normal in arrangement and distribution, (3) little or no disturbance in peristalsis and retention is uncommon except when the lesion is at or near the pylorus, (4) absence of a niche, neither is there any incusura or other signs of spasm, (5) close and complete approximation of the walls of the barium filled stomach. Moore pointed out that though these signs are not characteristic they are at least suggestive. Differentiation, roentgenologically, between benign tumors and other gastric lesions can seldom be absolute but in many instances the x-ray signs warrant an attempt at such a differentiation.

More recently the radiologists have become keen to recognize gastroduodenal invagination. Some have reported complete radiographic diagnoses before operation and Schmitt[46] has formulated features as typical for cases which are not acutely obstructed.

1. *A central area of translucency* in the bulb accompanied by transitory, moderate foreshortening of the antrum and a slight shift of the pylorus to the left at the beginning of the examination. This translucency is caused by the intussusceptum which prevents the accumulation of barium.

2. *Converging axial striations* present in the stomach and/or the duodenum. These striations (Fig. 5-(2)(6)) are longitudinal, running parallel to the long axis of the gut. They are caused by the tension created on the cardial portion of the stomach and converge towards each other as the pylorus and duodenum are reached. These axial striations represent streaks of barium within the mucosal folds in the lumen of the intussusceptum.

3. *Parallel transverse striations* running perpendicular to the axial striations but parallel to each other. (Fig. 5-(2)(3).) They are due to the barium in the lumen of the intussuscipiens and thus lie external to the converging axial striations. Both forms of striations are usually best seen in the vicinity of the pylorus. Zdansky[54] observed an instance in which the axial striations extended beyond the pylorus into the inferior horizontal portion of the duodenum and the transverse striations were in the region of the duodenojejunal flexure. (Fig. 5-(6).)

Our own case radiologically showed an abrupt delineation of the contrast medium running approximately across the middle of the stomach. (Fig. 1.) A few spurs of barium are evident extending parallel to the long axis of the stomach. These streaks, in retrospect, can now be interpreted as the equivalent of the longitudinal striations. Most of the barium was blocked sharply but enough leaked between the invagination and the stomach wall to cause the spurs. Bogara's case[50c] showed a comparable sharp delineation of the contrast medium. Saupe[43] recorded an instance that shows a linear demarcation and spurs. Bignami's case[6] at the beginning of the observation presented this "abrupt sign" but during subsequent examinations the x-rays showed features which though not as crass as Zdansky's are as illuminating and as typical as Schmitt's. V. Hoyningen-Huene[51] illustrated his report with a roentgengram which is almost the counterpart of our own.

In summary, radiologically, Moore's signs are in part applicable. In gastroduodenal invagination supplementary features can be encountered which consist of

converging axial and parallel transverse striations. These may be absent and in their stead the "abrupt sign" with or without spurs be available.

Therapy. A natural cure may ensue by separation of a polyp following torsion or strangulation of its pedicle. Beardsley[53c] described a case in which spontaneous detachment of a gastric polyp occurred and it was vomited by the patient. Myer[33] reported a small tumor appearing in the wash water during a gastric lavage in a case of polypositas of the stomach. Later, this patient expelled a large polyp in the feces following a hemorrhage from the bowel. Such also happened in Chosrojeff's patient.[33c] These spontaneous therapeutic successes are interesting; the rational treatment for a benign tumor of the stomach is surgery. The indications for removal, according to Kieffer,[27] become definite and absolute when obstruction, chronic blood loss or the impossibility of excluding malignancy are factors. "The weight of statistical incidence is so heavy in the direction of malignancy and the penalty for error so great that reliance upon differential findings or roentgenologic and gastroscopic examination is not feasible. The possibility of subsequent malignancy presents another indication for the surgical excision of all benign tumors."

The choice of operation varies according to different authors. Kieffer suggests a fairly wide resection of the stomach from which the tumor arises (at the cardia the difficulties would restrict the surgeon to local excision). Rumold[42] wrote: "If the presence of a benign tumor is suspected an exploratory operation and removal of the tumor with its involved wall are indicated. Removal of the stomach wall is necessary since there have been reported cases of recurrence where only the tumor was removed." Yet, Finesilver[21] recommends: "In the majority of cases of benign tumors of the stomach local excision rather than resection is indicated. The procedure most frequently used in our series was transgastric excision performed through an incision in the anterior wall of the stomach and division of the mucous membrane pedicle."

In the event of an intussusception the problem of local excision versus resection of a gastric tumor is more apt to be settled in favor of the latter. The excess amount of tissue, the severe degree of slack, the possibility of malignant degeneration, the loss of viability in the tissues surrounding the tumor would all urge resection of the involved portion of the stomach.

The rapid onset of symptoms, the picture of ileus that suddenly develops, the abrupt development of an acute condition of the abdomen all make surgery imperative in gastroduodenal invagination. The prognosis is defined by the degree of prostration, the severity of damage to the bowel, and the ability of the patient to withstand the operation. With the tissues showing no evidence of distress, disinvagination can be effected and the prolapsed side of the gastric tumor resected. Further surgery on the remainder of the bowel was not performed in any of the reported cases.

Pathogenesis. Features in the anatomy of the stomach are cited as preventatives for invagination: Its truncated configuration, fixation of the cardia and of the pylorus, fixation by the gastrohepatic and gastrocolic ligaments. The pear shape of the stomach supposedly prevents the intussusceptum being held by the intussuscipiens. Morbid features must be present for an invagination to develop and most usually it is due to a tumor of the stomach or mucosal tumifaction. These act as a foreign body within the lumen of the gut and excite the bowel to expel the tumor. Peristalsis carries it into the succeeding bowel segment and the tumor pulls the stomach after it. The tumor causes spasmodic contractions of the gut around itself but inhibition of the distal bowel segment (Wardhill[8c]). Thus the bowel is prepared to invaginate and the contracted portion with the tumor may enter the dilated segment. Chiari[45c,52c] *explained intussusception on the basis of a difference in the mode of gastric contrac-*

tions: Undulating in the fundus and sphincter-like in the antrum. Vulliet[52] and Thompson[52a] verified the mechanism of excitation of peristalsis associated with traction by the tumor. The tumor is always the determining factor which arouses a foreign body mechanism. Baylac and Dieulafé[3] also see the tumor as the primary factor with ptosis of the stomach, dilatation, and atonia serving as predisposing qualities.

Schmieden and Westhues[45] demonstrated on cadavers the impossibility of producing invagination when traction was applied to that segment of the stomach which is 2 to 3 cm. oral from the pylorus. In this area the traction is immediately disseminated to the lesser curvature. If, however, traction was applied 10 to 12 cm. above the pylorus the invagination could be easily induced. These authors postulated two phases in the genesis of gastric intussusception: (1) an active invagination of the stomach into the duodenum due to the traction of the tumor (or polyp); (2) a passive invagination due to a mobile duodenum gliding over the stomach after arrest of the first phase by the gastric ligaments. As prerequisite conditions for this invagination they enumerated: Frequent lesser invaginations, stretching of the tumor pedicle, gastrectasia, mobility of the duodenum, enteroptosis, and stretching of the gastrocolic ligament.

Repeated lesser invaginations frequently precede an occluding invagination. Rothe[41] followed such an oscillating instance for five years. Also others[6,22,58] speak of recidivating prolapse of the stomach or of a gastric tumor. The symptoms are transitory and vague but with engagement of the intussusception or of the tumor the aspects change rapidly. Concerning the unnatural mobility of the duodenum which facilitates the descent of the intussusception, it might be said that this feature was observed in four instances.[14,23,45,53] Generally such a finding is not recorded; neither did our case reveal defective fixation of the duodenum.

The mode of development of gastro-duodenal invagination with an external mechanism is different. The stomach glides isoperistaltically and surrounds the first portion of the duodenum. Fixation of the aboral bowel segment is an absolute requirement. In one case (Fig. 5-(5)) a cholelithiasis and pericholecystitis were the cause of the fixation. In a second (Fig. 5-(7)) a prepyloric gastric tumor became impacted and anchored the bowel; the stomach propelled by a second tumor then enveloped the immobilized portion. Osedallore[37] was able to duplicate this mechanism experimentally. He infiltrated the antrum of the stomach in dogs with 0.001 per cent silver nitrate which caused a hard dense edema and elicited this form of invagination. Berman[4] has adopted this mechanism in his treatment of peptic ulcer.

Brief mention should be made of two reports of double invaginations involving the stomach. One[11] was a case of gastroduodenal invagination on the basis of a myoma and multiple polyps of the stomach. The invaginatum descended into the jejunum and at autopsy was found associated with a secondary, more distal invagination of the jejunum into itself for a distance of 8 cm. The second case[15] was an example of a gastroduodenal intussusception which in turn telescoped itself into the jejunum. The precipitating factor was a gastric polyp arising just inside the pylorus and which prolapsed into the first portion of the duodenum. This herniation acted as a plug and caused a spasm of the bowel about itself. Thereupon, the latter and the surrounding gut slipped into the jejunum. A cross section of this area disclosed jejunum, duodenum, stomach wall, and the polyp in concentric layers. At autopsy five taeniae saginata were also found to which the authors ascribed etiological significance for the origin of the second intussusception.

SUMMARY

1. A classification of invaginations as they occur in the alimentary tract is given in the introduction.

2. The history of a sixty-eight year old woman is related who experienced a gastroduodenal invagination eight years ago, the basis for which was a submucous gastric lipoma.

3. The benign tumors of the stomach are briefly reviewed (Table I) and their incidence compared with gastric cancers. Lipomas constitute about 3 to 4 per cent of the benign gastric tumors. Ours is the thirty-ninth to be reported in 120 years.

4. All instances of gastroduodenal invagination have been assembled from the literature. (Table II.) A classification of the entity is proposed. Approximately 3 per cent of the stomach tumors have invaginated.

5. Symptoms of this disease are variable and multiple. Moore's roentgenological criteria for a benign gastric tumor are mentioned and the signs of Schmitt for gastroduodenal invagination are reviewed. A supplementary "abrupt sign" is presented.

6. A tumor of the stomach or mucosal tumifaction causes a foreign body mechanism and excites the bowel to expel the tumor. The latter then pulls the stomach after itself. Predisposing factors facilitate the occurrence.

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VARICOSE VEINS

TEN YEARS' OBSERVATION ON TREATMENT

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FOR the past ten years I have been interested in the surgical treatment of varicose veins which consisted chiefly in the resection of the proximal end of the great saphenous vein, together with separate division and ligation of the uppermost tributaries of this vein, and the subsequent injection into the veins with a sclerosing solution. The technic of this operation was described by Heyerdale and myself in 1940.[1] At the same time we demonstrated the various anatomical factors that frequently brought about the recurrences of varicosities following treatment.[2] We considered that of primary importance in the recurrences was a dilatation of collateral vessels (namely, overlooked tributaries) that acted as a shunt around the site of ligation of the saphenofemoral junction. Through these shunts, hydrostatic pressure augmented by spasmodically variable intra-abdominal pressure is brought to bear on the veins distal to the site of ligation.

It is, therefore, necessary to divide and to ligate, at the proper site, not only the great saphenous vein, but also its tributaries, separately. A number of variations in the relationship of these tributaries to the parent vein were described and their importance as factors in the recurrence of the varicosities stressed. In many instances a dilated superficial femoral vein had been mistaken and ligated for the great saphenous vein. In certain cases the failure to excise a segment of the saphenous vein lead to recurrence of varicosities owing to canalization. We also stated that the injection of a sclerosing solution at the time of operation, into the portions of divided veins distal to the site of ligation, was a definite advantage. I have treated a large series (several hundred) by this method and have observed the results in many instances throughout the past ten years. All of my original observations have been repeatedly confirmed during the period, not only by myself, but by others. A few of these observations I have modified and additional observations in the treatment of varicosities have been made. It is the purpose of this paper to describe these modifications and added opinions.

USE OF THE SCLEROSING SOLUTION

Injection at Time of Operation. I have mentioned that I believed the injection of sclerosing solution at the time of the operation was exceptionally important and of definite advantage. I still believe that in the majority of cases there is an advantage in injecting a small amount of sclerosing solution at this time, the dose to be predicted on the basis of individual sensitivity test to the sclerosing agent. It is advisable to keep patients ambulatory following surgery, and in the majority of instances they are allowed to leave the hospital immediately following or shortly after surgery. Due to the number of patients who now have hospitalization insurance, it has been necessary for them to enter the hospital for economic reasons to obtain their medical insurance to which an out-patient would not be entitled. In all instances these patients are made to be ambulatory throughout their hospital stay.

There were a few cases in which the reaction to the sclerosing solution at the time of operation was much greater than anticipated, and it caused sufficient pain to necessitate bed rest. For this reason I now inject only approximately 50 per cent of my patients at the time of operation.

The 50 per cent I do not inject at this time are selected for various reasons, namely, (1) advanced varicosities associated with marked dilatation of the saphenous vein; (2) hypersensitive individuals as indicated by the response to the test dose and their reaction to the operative procedure which is performed under local anesthesia; (3) those cases in which an open ulcer or a potential ulcer exists; (4) those cases in which a previous history of deep thrombophlebitis is present, but examination revealed adequate recanalization of the deep veins; (5) pregnancy; (6) patients in whom there is already existing superficial thrombophlebitis; and (7) those cases in which segmental ligation is carried out. I believe that it is important to inject at the time of operation those patients who have only moderately advanced varicosities and have a relatively small incompetent great saphenous vein.

Postoperative Injection. I have always believed that the postoperative injection of the sclerosing solution so that complete obliteration of the varicosities occurs has been of equal importance with the operation. This has been demonstrated in a few of my cases in which it was not possible to complete treatment due to the fact that I entered the Army, or that they were already satisfied with the immediate results of the ligation and a few strategically placed injections. Although patent communicating veins had not been demonstrated in these cases prior to surgery, I am certain that in a number of instances communicating veins became incompetent and the superficial veins recanalized or persisted as varicosities. This was particularly true when the patient became pregnant and had a resulting increased intra-abdominal pressure. I believe that in these cases a back pressure occurred in the deep venous system with a resulting dilatation of the communicating veins.

COMMUNICATING VEINS

It has been my belief that in many instances too much stress has been placed on the presence or absence of communicating veins, as in most cases such situations can be handled by adequate sclerosing. This, however, is not true if a lesser saphenous incompetency exists. In some patients, particularly those who have advanced varicosities, large communicating veins can be demonstrated. These are most commonly seen in the region of the middle third of the thigh and the inner aspect of the knee. Invariably when a patient has had a deep thrombophlebitis with resulting compensatory superficial varicosities, the communicating veins will be found to have been dilated considerably. Subsequent to this compensatory dilatation, the deep venous system may recanalize and establish an adequate circulation which makes it possible to institute surgical therapy. When communicating veins of the type mentioned exist, separate ligation of the saphenous vein and the communicating veins at the demonstrated levels should be carried out. It has rarely been necessary to ligate more than one or two communicators in a single extremity, and invariably those have been in the two sites mentioned.

LESSER SAPHENOUS VEIN

Normally there is a communication between the greater and lesser saphenous veins, and in the majority of cases dilatation of a lesser saphenous vein is secondary to a valvular breakdown in the great saphenous vein. In approximately 7 per cent of my patients there has been major involvement in the lesser saphenous vein with incompetency in this system. In these instances it is advisable to ligate the lesser saphenous vein separately just as it enters into the deep venous system.

SEGMENTAL LIGATION

In individuals with advanced varicosities and markedly dilated saphenous veins, segmental division and ligation of the saphenous system is advisable regardless of the presence or absence of communicating veins. When one ligates such a

dilated saphenous vein at the sapheno-femoral junction and injects a sclerosing solution into the distal portion, a hugh thrombosis with a marked phlebitis frequently occurs throughout the entire system. This causes great discomfort to the patient and may make it difficult for him to be ambulatory for a matter of a few weeks. If, however, one segmentally divides and ligates this vein and treats the individual segments in accordance with the patient's reaction, it is possible to keep the patient ambulatory and working throughout the course of treatment. In many of these cases, segments will develop localized phlebitis and become obliterated without injecting the sclerosing agent.

SUMMARY

Certain observations made in the surgical treatment of varicose veins during the past ten years have been reviewed. The injection of a sclerosing solution at the time of surgery does not seem advisable in all cases. Those cases in which this is not advisable have been mentioned. The importance of complete sclerosing obliteration of the varicosities subsequent to surgery has been stressed. When large communicating veins can be demonstrated, separate division and ligation should be done. When a hugely dilated saphenous vein is present, segmental ligation seems advisable. The importance of treatment of the lesser saphenous vein has been stressed.

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ORCHIECTOMY IN THE TREATMENT OF CARCINOMA Of THE PROSTATE*

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THE successful treatment of carcinoma of the prostate is a difficult problem. "It is progressively obstructive (50%); occurs late in life (65–80); tends toward metastasis (35%); is usually painful (75%); produces cachexia, and affects 15% of men over 50 years of age."

Early diagnosis of this disease is important for its successful treatment. The responsibility of early diagnosis falls, as a rule, upon the general practitioner, whose suspicion should become aroused when his examining finger in the rectum palpates any hard nodule or any series of irregular hard nodules in the prostate. Most patients, when first seen by the urologist, have extension of the disease beyond when the radical perineal prostatectomy of Young is indicated.

The treatment of carcinoma of the prostate by partial prostatectomy (suprapubic or perineal) or by transurethral resection has been augmented by the research work of Huggins. He reported on his treatment of prostatic carcinoma by surgical orchiectomy; Munger by irradiation of the testes. The work of both these men has revolutionized the treatment of this disease. Since Huggins' original communication there have been many reports from clinics all over the country and writers have expressed opinions varying from those of hopeful optimism to the other extreme (probably the truth lies somewhere between these extremes).

In his original reports, Huggins states that this disease is inhibited in two ways: (1) by bilateral orchiectomy which removes most of the testicular androgens; (2) by neutralizing androgenic activity. Conversely, he notes that the disease may be reactivated by injections of androgen. Inhibition of the androgens by estrogen is unsound because it is incomplete; moreover, partial inhibition is temporary and estrogen must be administered for a long time. In many species the administration of estrogen to males for a long period is in itself carcinogenic. With Huggins, we believe that bilateral orchiectomy is the method of choice as a basic treatment in advanced or metastatic prostatic carcinoma.

When metastasis begins to occur, (to the bony pelvis, lumbar vertebrae, ribs, lungs, and to the prevertebral chain of lymph nodes) there is pain due to impingement upon the nerves. There is a rise in the serum acid phosphatase (which normally is 1.5 to 3 King and Armstrong units per 100 cc. of blood) to values above 5 units when there is extension of the malignancy beyond the confines of the gland capsule. Removal of the chief source of the androgens usually produces a drop in serum acid phosphatase values, an abrupt decrease in pain, and roentgenological evidence of the disappearance of bony metastases. There is also a shrinkage of the mass of malignant tissue in the prostate, often sufficient to permit the passage of urine with more ease even when no operation has been done on the prostate.

The following is a statement from the

Paul-Lewis Laboratories: "*Acid Phospha-tase:* Normal values for the acid phospha-tase activity of serum when determined by the method described (modified King and

carcinoma, and until more of these tumors are discovered at a stage where complete removal is possible, there can be little hope for improvement in the prognosis.
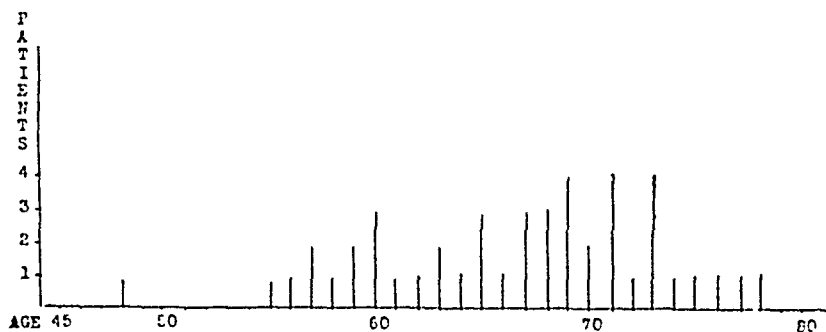

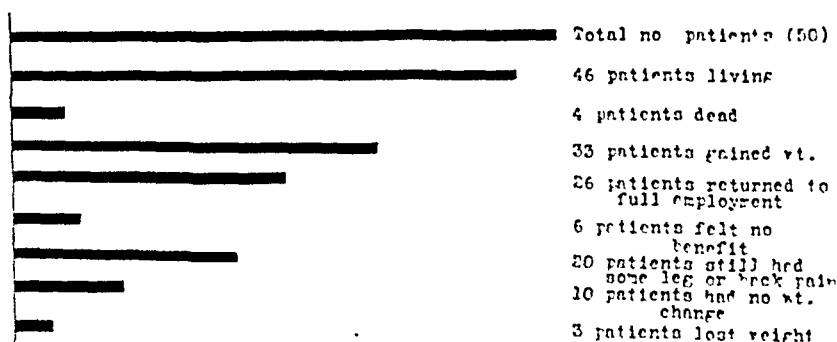FIG. 1. Number of patients and the age groups.

FIG. 2. Results.

Armstrong technique) range around 3.25 units per 100 cc. of serum. Values falling below 5 units per 100 cc. of serum may be regarded as lying within the normal range. Values between 6 and 10 units per 100 cc. of serum are suspicious of prostatic car-cinoma and should be confirmed by further determinations, over an extended period of time if necessary, and supple-mented by other diagnostic procedures, cystoscopy, biopsy by transurethral or perineal routes, and roentgenologic in-vestigation for skeletal metastases. Values over 10 units per 100 cc. of serum are diagnostic for prostatic carcinoma with metastases."

No claim is made that orchiectomy, estrogen therapy, or any combination of both of these, cures the cancer. For this reason these procedures should supplement and not supplant other indicated surgical procedures. Complete surgical removal is still the ideal treatment of prostatic

We are reporting a total of fifty-four cases of carcinoma of the prostate or-chiectomized at the Urological Clinic at St. Vincent's Hospital during 1941 to 1942. Forty-seven were confirmed by examination of tissue removed and only three were diagnosed by x-ray and serum acid phosphatase values. Eighty-eight per cent of the patients have shown definite clinical improvement of their subjective symptoms, as evidenced by their answers to the following questionnaire which was sent to the fifty patients, all of whom, fortunately, answered the query:

(Please advise yes or no and add any further details pertaining to your present complaints on the reverse side.)
Name:
Address:
1. Are you able to pass your urine normally?
2. How often do you urinate during the day_____night_____?

3. Have you had any urinary bleeding since leaving the hospital?
When_____?
                month   year
4. Is there any pain or burning on passing urine?
5. Have you gained weight?   Yes_____
No_____
6. Have you lost weight?   If so, how much?
7. Has your appetite and general health improved since you were operated?
8. Do you consider yourself to be improved or unimproved?
9. Are you doing the work you did before you were operated upon?
10. Are you able to do any kind of work?
11. Have you been relieved of the symptoms of which you complained when you came to the hospital?
12. Have you had any pain involving your hips, legs or back?
13. Have you had any severe headaches before or since operation?
14. Are you undergoing any treatment for your bladder or prostate at the present time?
15. Have you had to be reoperated?   If so, when and where?
16. When was your last visit to this hospital for treatment?
17. In your opinion has the operative work been a success, insofar as the relief of your symptoms and your ability to live comfortably is concerned?

This survey has shown that the average age for the occurrence of carcinoma of the prostate is 64.8 years with extremes of 48 and 78. Forty-six patients are still living (1945), four are dead of irrelevant causes. Twenty-five returned to full employment and are still working. Six patients felt no benefit. Thirty-three patients gained and have maintained their gain in weight. There was no weight change in ten patients and only three patients lost weight.

This report is being made because we believe that orchiectomy is the operation of choice in all cases of adenocarcinoma of the prostate, the exception being in those few cases that are seen early enough to do complete perineal prostatectomy (Young). We have analyzed these cases over a two-year period, giving a two- to four-year

report on most of them. Study of this report shows beyond any doubt that orchiectomy with or without estrogen therapy has given us the best clinical results. We are also presenting four case reports (which are not included in this survey) because of the unusual results obtained. It is difficult for us to understand the reports of several prominent urological surgeons who condemn the procedure or at least do not think the results justify the operation. We believe with McCarthy, of New York, that if no other result but the relief of pain were obtained, the operation has merit.

The intangible causes of mental distress following orchiectomy have been almost wholly eliminated by operations devised to leave visible evidence that the contents of the scrotum still remain (Chute, Lowsley, Tolston and Hess). Orchiectomy has in some cases voided the attack upon the bladder neck obstruction. Immediate relief of obstruction, either temporary or permanent, is accomplished by resection. A certain number of cases must also receive postoperative estrogen therapy.

REPORT OF FOUR UNUSUAL RESULTS

The following four remarkable cases are reported because of the unusually splendid results which can be directly attributed to orchiectomy:

CASE I. G. W. S., age sixty-five, a white male, with the chief complaint of burning and frequency, was admitted the first time December 20, 1939. Transurethral resection of the prostate was done. Diagnosis: Adenocarcinoma, pathologically. The second admission on March 1, 1941, was made because of pain in his abdomen and difficult voiding with blood clots. We performed transurethral resection of the prostate. Diagnosis: Adenocarcinoma. X-ray showed no evidence of bony metastasis. The third admission on June 1, 1941, was because of urinary hemorrhage. A retention catheter was inserted and followed with bladder irrigation. On June 18, 1941, the patient was admitted again because he was unable to void. The patient had lost much weight. Suprapubic

drainage was begun; a large, soft malignant prostate and a mass in the left pelvis outside the bladder were found. The fifth admission on October 7, 1941, was made because of blood in his urine, urgency, frequency, pain over the bladder. The patient was emaciated and pale. Bilateral orchiectomy done and the suprapubic drain removed. The patient returned to the hospital to see if further surgery was necessary. The prostate is still enlarged and stony-hard, but not obstructing. No surgery was done, and there was no x-ray evidence of bony metastasis.

This patient is still alive (1945), has had no pain and has been able to void normally. He has had no further operative treatment, has gained weight and strength to the degree that he is able to resume his work as a chiropractor, and is able to work in his garden.

Case ii. W. J. H., age seventy-one, a white male, complained of frequency, difficult and painful voiding, and the need to get up eight to ten times at night since 1939. The patient was admitted to St. Vincent's Hospital on December 11, 1942, in a somewhat psychotic state. Transurethral resection of the prostate was performed. Diagnosis: Adenocarcinoma, pathologically. There is extension· of the malignancy to the bladder wall along the anterior vesical margin. Five days later bilateral orchiectomy was done, with immediate mental improvement. The patient is now employed as a machinist and has worked overtime during the past year or two. He has gained twenty or more pounds, and his nocturia is only one or two times. He has no pain.

· Case iii. I. W., age sixty-six, a colored male, complained of low back pain. He had been under the care of an orthopedic surgeon and in a cast for months because of a fractured vertebrae which came as the result of a fall. Due to the fact that the patient began to have voiding difficulty in the hospital, a urological consultation was had. The prostate was thought to be malignant. The patient was admitted to St. Vincent's Hospital on April 25, 1945. The serum acid phosphatase level was found to be 3 k. and a. units. X-ray examination showed a mottled appearance in several of the bodies of the vertebrae, with one of the vertebral bodies collapsed. A diagnosis of carcinoma of the prostate, with metastases to the spine, was made, and a bilateral orchietomy was done. There was immediate improvement in the low back pain and the ability to void normally was gradually restored. The patient is alive and well and able to work at the present time. There has been a definite gain in weight, and the patient has not had to wear a brace because of the condition of the vertebrae.

Case iv. F. L. C., age sixty-nine, a white male, complained of loss of weight and appetite. He was admitted to St. Vincent's Hospital on July 1, 1944. There had been a weight loss from 170 to 120 pounds in four months. There was no urinary complaint. Serum acid phosphatase was 24 k. and a. units on July 5th. Marked mottling of bony pelvis and lumbar spine was present roentgenographically. Bilateral orchiectomy was done followed by stilbestrol .05 mg. daily. Serum acid phosphatase was 2 k. and a. units on July 13th.

Since his operation, this patient has been relieved of his pain, has begun to gain weight, has been active again in his profession as an attorney, and is still alive (1945).

CONCLUSIONS

1. We believe, with Young, in total perineal prostatectomy for the very early case of carcinoma of the prostate. Unfortunately, we have never seen one of these cases at our clinic.

2. We believe that the proper method of treating adenocarcinoma of the prostate is to orchiectomize the patient. If there is obstruction, transurethral resection should be done. Most cases will require both procedures.

3. The report of fifty cases done in 1941 to 1942 and followed through 1945, justifies our position in the treatment of this disease.

4. Four remarkable cases are selected to illustrate the splendid improvement seen following bilateral orchiectomy and/or transurethral resection of the prostate gland.

5. We do ·not claim absolute cure in any patient but are more than satisfied with the relief from pain, the improvement in weight, and the ability to void in the majority of these patients.

DESICCATION OF RESIDUAL RED BLOOD CELLS FROM PLASMA PRODUCTION*

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IN a state-wide civilian blood plasma program such as that which is in operation in North Dakota,[1] large quantities of residual red blood cells are discarded as waste material. However, during the past six months these blood cells have been desiccated and distributed to physicians for use 'as a dressing material for various types of wound healing. The purpose of this paper is to present the technical procedure used in our laboratories for the production of dried human red cells.

Moorhead and Unger[2] presented a use for residual blood cells resulting from the mass production of plasma. They used red blood cells in the form of a gelatinous mass as a dressing material for wounds such as open ulcers, infections, etcetera.

Seldon and Young[3] used the foregoing method at the Mayo Clinic but encountered difficulty in keeping the semi-liquid material in contact with the wound. They observed that it was either absorbed by the dry gauze dressings or ran out of the wound. Because of this experience, they decided to dry the gelatinous mass and use it as a dusting powder. Dr. A. E. Osterberg, using the Harper and Osterberg[4] method for drying blood plasma, reduced the semi-liquid mass of red blood cells to a fine powder.

Seldon and Young[3] report that the powder worked satisfactorily in many instances and they cite case reports to bear this out. They recommend that the powder be dusted on the wound or applied with a sterile spatula, then covered with a dry, sterile dressing. One or two applications are used daily. The types of cases which they have treated with dried red cell powder have included infected wounds, postoperative abdominal wounds which had not healed above the fascial layer, certain proctologic cases, varicose and other ulcers of the leg, amputation stumps, open chest wounds, and so forth. They report that results have not been uniformly beneficial but were sufficiently promising to warrant more investigative work along this line.

After the report of Seldon and Young[3] was read and after several requests for red cell powder were received from local physicians, it was decided to work out a procedure for the drying of the residual blood cells for free distribution' to the medical men in North Dakota. The process of desiccation is essentially the same as that used in the preparation of dried blood plasma. The method and apparatus used in the drying of the red cells is that devised by Strumia and McGraw[5] for the dehydration of plasma. This method and apparatus is being used in the preparation of blood plasma for state-wide distribution. The apparatus† does both shell freezing and drying of material, is easy to operate, and is economical to run.

LABORATORY PROCEDURE

Pooling. Blood to be used for plasma is collected in a 650 ml. rubber-stoppered bottle containing 50 cc. of saline-citrate solution. The plasma is separated from the red blood cells by centrifuging for one hour at 2,500 r.p.m. The plasma is then

† Constructed by Precision Scientific Co., of Chicago, and distributed through A. S. Aloe Company, St. Louis, Missouri.

·aspirated from the packed cells, which remain in the lower half of the bottle.

These remaining cells are removed by aspiration into a four-liter bottle, each pool containing between 3,500 to 4,000 cc. The pooling is done in a sterility room and is handled in a manner similar to that used in pooling plasma. The cells are filtered through a gauze filter contained within the pooling bottle. The cells are thoroughly mixed by gentle agitation and are allowed to stand at room temperature for about four hours, after which cultures are made to determine sterility. Approximately 5 cc. of cells are seeded in a 30 cc. rubber-stoppered serum bottle containing 20 cc. fluid thioglycollate medium.

After the initial culturing, a 1:50,000 dilution of phenyl mercuric borate is added as a preservative. The pools are then placed in a refrigerator for approximately forty-eight hours before being dispensed. At the end of forty-eight hours the first cultures are checked and a second set of cultures is prepared at the time of dispensing.

Dispensing. The cells are dispensed by positive pressure directly from the pool into the bottle which is used for drying. The cells must be diluted before shell freezing prior to desiccation can be accomplished. Since all the plasma has been removed, the cells are a heavy thick mass; therefore, 50 cc. of cells is dispensed into a sterile rubber stoppered 400 ml. round bottle containing 200 cc. normal saline solution.

Shell Freezing. The procedure followed in shell freezing the cells is that outlined by Strumia and McGraw[5] and used in our laboratories for shell freezing of plasma. The cells are mechanically shell frozen by rotating the bottle (½ to 1 r.p.m.) with 12 mm. immersion in alcohol cooled to minus 30°C. The time required for this procedure is between forty-five minutes and one hour and with the machine we are now using twelve bottles can be frozen every hour.

When the cells are frozen, the bottles are placed in a storage cabinet at minus 20°C. until they are to be desiccated.

Drying. The standard apparatus[5] used can dry twenty-four bottles of red cells every twenty to twenty-two hours. Drying of the red cells from the frozen state is accomplished by low temperature water condensation in vacuo.

The dried plasma obtained with this apparatus is a light, porous material, with a distinct crystalline structure and may readily be reduced to a fluffy powder by shaking the bottle. On the other hand, the red cells, though they are porous and have a crystalline structure after drying, cannot be reduced to a powder through shaking. They must be removed from the bottle, placed in a sterile mortar and ground to a fine powder. This process is carried out in a sterility room with all necessary aseptic technic. As soon as the material has been reduced to a fine powder, it is dispensed into 4 ounce sterile powder jars with screw caps.

The final product is a rusty brown fine porous powder, containing not more than 1 per cent moisture, readily soluble in water. When re-dissolved in normal saline solution, smears stained with Wright's stain show no definite cellular structure, the red cells, as one would expect, are completely disintegrated during the drying process.

CLINICAL USAGE

The dried red cells, as produced with the described procedure, have been used with success. The material was sent to a few private practitioners to determine whether or not production of this product was feasible. Since then requests for these dried cells have been received from other physicians. Reports received on the usage have been very gratifying. One physician writes that he used these cells on a chronic indolent ulcer of the leg with remarkable progress in clearing up of infection and in epithelization. Another report received was on a very severely ulcerated ulcer of the leg with infection;

dried red blood cells improved the condition much and healing was rapid. Other reports have indicated the use of dried cells on indolent ulcers, slow healing processes of various types and on burns. This treatment has appreciably hastened the healing of all cases in which it has been used.

Dried red cells are now being distributed free of charge to all physicians and hospitals in North Dakota. Accumulated reports may give interesting data concerning their use and may lead to the further development of a better product.

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HEMOSTASIS is essential to primary wound healing. The formation of a hematoma within a wound prevents coaptation of the wound margins, prolongs cicatrization, and predisposes to infection. If large clots develop in wounds, evacuation may be necessary; but opening a wound to remove blood or serum invites infections.

From "Operations of General Surgery" by Thomas G. Orr (W. B. Saunders Company).

ACROMIOCLAVICULAR JOINT INJURIES

A MODIFIED CONSERVATIVE FORM OF TREATMENT

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IN our experience, the most frequent injury to the shoulder joint, which is incurred during infantry combat training, is that to the acromioclavicular joint. This injury is usually the result of a direct downward and forward blow upon the upper portion of the scapula. A forward somersault over a small obstacle should be executed with a roll and thus avoid any direct trauma to one particular area. Occasionally the soldier slips and instead of rolling, he lands on the "top of the shoulder." The sudden shock is then absorbed in the area of the dorsal aspect of the acromion and the spine of the scapula. The force tends to push the scapula downward and forward.

The articular surface of the acromion faces upward, inward and forward against the outer aspect of the clavicle. A downward, forward and outward force on the scapula tends to shear the articular surface of the acromion away from the clavicle in its forward plane.

There are two strong ligaments which resist this shearing motion: (1) The superior and inferior acromioclavicular ligaments which surround this small joint; (2) the coracoclavicular ligament which is divisible into two parts, viz., the conoid and trapezoid ligaments. .

The acromioclavicular ligament, being the weaker, gives way more readily. An injury of moderate severity results in a sprain of this ligament. A more severe injury may rupture part or all of the fibers composing the acromioclavicular ligament and result in variable degrees of subluxation. A very severe injury may also rupture the coracoclavicular ligament, either partially or completely. Hence, the extent of sprain or rupture varies directly with the severity of the trauma.

The downward pull on the acromion is exerted by the weight of the upper extremity plus the pull of the pectoralis major and the latissimus dorsi. The upward pull on the clavicle is exerted by the upper fibers of the trapezius. Both forces tend to maintain a strain on traumatized ligaments or a separation of partially-ruptured ligaments.

The largest number of these injuries which we encountered were those varying from a severe sprain to a partial rupture of the acromioclavicular ligament. Most of these cases showed no evidence of subluxation. About 35 per cent showed variable degrees of mild subluxation. .

It was believed that any form of fixation which would hold the clavicle down and push the acromion up would force the surfaces of the acromioclavicular joint together. This would aleviate a constant strain on the contused or partially ruptured ligaments and promote healing.

Since most of our injuries were severe sprains or those with a minimal degree of subluxation at the acromioclavicular joint, operative intervention appeared unnecessary. An attempt was made to secure some form of conservative treatment which would be practical, easy to apply and answer the purpose from a mechanical point of view.

Thorndike and Quigley,[1] Hart,[2] Shaar,[3] Benson,[4] Copher,[5] Trynin,[6] Mercer,[7] Key and Conwell[8] and many others have all described various modifications of conservative treatment for this type of injury. The author claims no originality for this method of treatment, for in reality, it is a modification of that used by many other surgeons.

A three-inch roll of adhesive, two soft felt pads measuring 3 inches by 2 inches by ½ inch, any skin glue or adherent, and one pound bag of weight is all that is necessary. The area of the back, shoulder

and forearm to be covered by the adhesive are first painted with the skin glue. This prevents slipping of the adhesive and

the back, to end close to the area where the first adhesive plaster was started. A one pound bag of weight is then strapped

FIG. 1. Front view of sling applied to the patient.

FIG. 2. Rear view of sling applied to the patient.

protects the skin. One pad is placed over the distal end of the clavicle. The other pad is placed over the ulna, just distal to an imaginary line dropped from the inner border. of the biceps brachii when the elbow joint is flexed to a right angle. (Fig. 2.) It is not necessary to exert any tension on the adhesive. The first strip is carried over the upper pad, down to the flexed forearm. (Fig. 3.) The second strip of adhesive is started just distal to the upper pad, face to face with the first, to which it is adhered. The forearm is held at about 85 degrees of extension. This second strip of adhesive is carried around the ulnar aspect of the flexed forearm, from behind—forward, under the lower felt pad. The adhesive part extending from the forearm to the upper pad is covered with a third piece of adhesive. The second strip of adhesive is continued over the upper pad and down

to the dorsum of the wrist joint. (Fig. 1.) In this manner, the adhesive plaster between the upper and lower pads is covered face to face in order to avoid any exposed adhesive surface. The patient is encouraged to be up and about the ward or to sit in a chair as much as possible.

The mechanics of this dressing is based upon the principle of a second degree lever. The fulcrum is located at the lower felt pad. (Fig. 4.) The downward force on the lever is composed of the weight of the forearm, hand and bag of weight. The upward force on the lever is exerted on the short arm just proximal to the lower felt pad. This upward force is carried to the humerus, which in turn, elevates the glenohumeral joint, thus raising the scapula and the acromion. The downward pull on the adhesive depresses the clavicle.

Simple sprains of the acromioclavicular ligaments are held in this form of "lever

dressing" until all symptoms subside. In our experience this has usually been necessary from four to fourteen days, depending upon the severity of the injury.
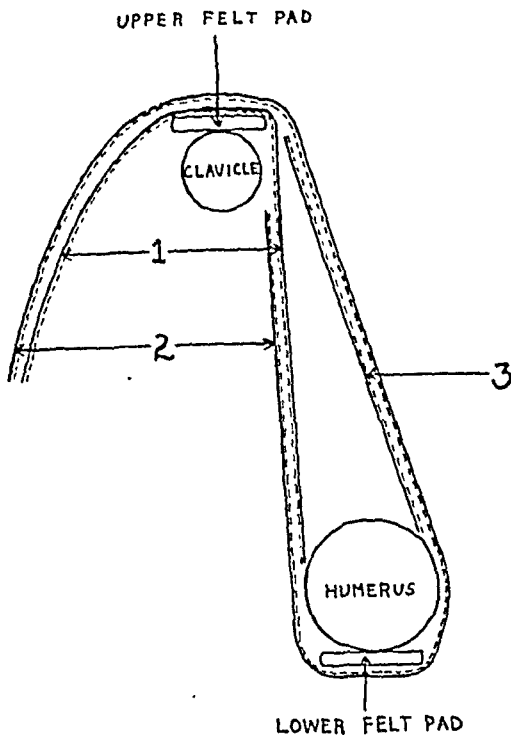

FIG. 3. Schematic drawing demonstrating how the three strips of adhesive are applied. The broken line demonstrates the adherent side of each strip.

When the case presented showed evidence of a mild subluxation, either clinically, roentgenologically, or both, the sling was kept intact for a period of three weeks. No stiffness of the shoulder or elbow joints was encountered after the sling was removed in any of these cases and all were returned to full military duty.

SUMMARY

Approximately fifty-three patients with mild to moderate injury to the acromioclavicular joint were treated with the "lever type" of sling described. Sixty-five per cent were simple sprains. Thirty-five per cent were diagnosed clinically and radiologically as mild subluxations. The sprains were immobilized for variable periods ranging from four to fourteen days, or until all tenderness subsided. The subluxations were immobilized for three weeks. No case was

hospitalized more than four weeks. All patients were asymptomatic and had a full range of strong, active motion upon discharge to full military duty.
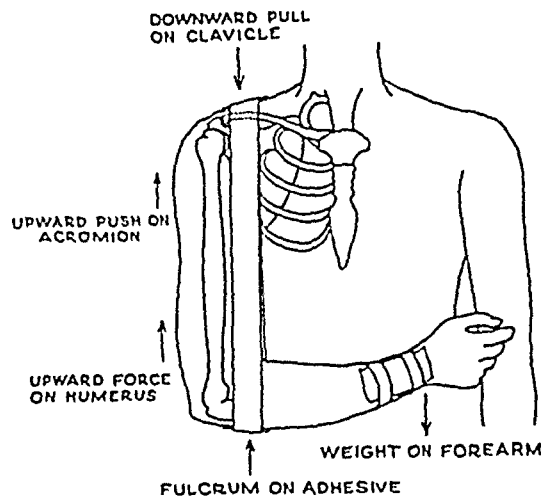
FIG. 4. A drawing to demonstrate the mechanical principles of the sling.

CONCLUSION

A modified "lever type" adhesive sling has been used in the conservative treatment of injuries to the acromioclavicular joint. The injuries varied from those of simple sprains to mild dislocations. All patients returned to full military duty. In the author's experience, this modified form of conservative treatment for the more usual injuries to the acromioclavicular joint has met with satisfactory results.

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MEAN DISPOSITION OF TIBIAL SHAFT FRACTURES

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SINCE it is well known that fractures of the tibial shaft are among that group of fractures more prone to non- and mal-union, an analysis of the statistical data of such fractures from the point of view of long-term results should be of interest.

Material. The cases reviewed were gathered from the clinical records at an Army General Hospital within the United States. In selecting the material, only cases that truly represented tibial shaft fractures were included. Thus Pott's fractures, tri-malleolar fractures, and fractures of the tibial plateau were excluded, as were fractures that mainly involved the femur and knee joint with minor involvement of the tibia, or fracture of the astragulus and os calcis with slight tibial malleolar involvement. These cases covered a two and a half year period and for the most part the patients were evacuees from the various combat theaters of the world. They include both simple and compound fractures, and these will be considered together for the sake of comparison. That more tibial fractures were treated is obvious, but an effort is made to consider only a selected group. This group numbers 120 cases, fifty-two (43 per cent) of which were compound, and sixty-eight (57 per cent) of which were simple. It is to be remembered that other fractures were present for the most part in these cases. The accompanying fractures ranged from fibular fractures of the same leg to concomitant fractures of the pelvis, patella, femur or bones of the ankle; but all cases fulfill the requirement of a tibial shaft fracture.

Initial Treatment. Initial therapy in most of the cases of simple fracture was the application of the Army leg splint and evacuation through the medical chain to a Field or Evacuation Hospital, where closed reduction was accomplished and casts applied. Many of these cases arrived with the second cast on, these being usually in excellent condition and the fractures in good position. Compound fractures usually received initial sulfa therapy locally and the Army leg splint was used. Débridement and open packing with vaseline gauze and application of a cast were usually carried out at the Field or Evacuation Hospitals. In more recent cases, courses of intramuscular penicillin have been used at times, effecting a seemingly somewhat earlier reduction in drainage. These cases usually arrived with their third or fourth cast intact and in good condition.

Analysis. Table I gives a breakdown of the cases from the point of view of the region of the shaft that was fractured.

TABLE I

	Simple		Compound		Total	
	No.	Per Cent	No.	Per Cent	No.	Per Cent
Upper third....	5	7	18	35	23	19
Middle third....	13	19	10	19	23	19
Lower third....	50	74	24	46	74	62
	68		52		120	

The more even distribution of the compound fractures along the shaft of the tibia is to be expected, for most of these occurred as a result of enemy action.

Other fractures were present in the group of sixty-eight simple fractures in sixty cases (88 per cent). Other fractures were present in the group of compound fractures in thirty-four cases (65 per cent) of the fifty-two cases.

Table II gives the mean disposition of

TABLE II

Disposition	Simple		Compound		Total	
	No.	Per Cent	No.	Per Cent	No.	Per Cent
Duty..........	51	75	24	46	75	63
Discharged.....	6	9	16	31	22	18
Other..........	11	16	12	23	23	19
	68		52		120	

the cases thus far completed. Return to duty can be construed as a satisfactory result. The fact that a certificate of disability discharge was given, by no means precluded the possibility of the soldier returning to productive civilian life. The result "other" means for the most part that the soldier was transferred to another general hospital either nearer his home or for further treatment of some other condi-tion; for example, peroneal nerve paralysis, of which four occurred in the whole group, one with a simple fracture and three with compound fractures.

Thus 75 per cent of simple, and 46 per cent of the compound fractures were re-turned to duty, with an average of 63 per cent of the cases being so terminated. In this total group of cases, twenty-six soldiers required operation, ranging from curettement to bone grafting. Ten of the operations were performed on simple frac-tures, three of these being returned to duty. Sixteen operations were performed on the group of compound fractures, ten of which ultimately returned to duty.

SUMMARY

The mean disposition of therapy in a group of compound and simple tibial shaft fractures has been presented with an average of 63 per cent of all patients being returned to duty.

THE VENOUS CIRCULATION IS AUDIBLE THROUGHOUT THE SYSTEM AND IN FIBROID UTERI

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SINCE publishing my article in 1922,[1] dealing with the fetal heart sounds, I have pursued ausculatory research in that field until I have hit upon the observation which forms the theme of this article.

Women have often told me that during their pregnancies they felt fetal movements at ten weeks of its duration. I followed this lead and I have heard so-called fetal heart sounds even at nine weeks of gestation with the only difference that they were of a much lower pitch than at four months or over; in fact I frequently had to strain my ears to hear them. I did not, for a time, venture to listen for them at an earlier period; if I did, I would have heard them earlier. The low pitch and apparent weakness of the sounds I attributed to the youthfulness of the fetus. Thus I continued for a number of years until I encountered a few abortions, miscarriages and premature births which I had occasion to examine a day or two previous to such interruption; and it was found that the fetus had either been absorbed already or it was macerated. It then dawned upon me that, in order to obviate further diagnostic errors, a bony medium might be a better conductor of sound and, if so, a better interpretation might be made through such auscultation I forthwith listened at, on, in front of and behind the anterior superior spine of the ilium even at a week or two of pregnancy and in non-pregnant women and in men and was awarded with the same results. There were low pitched sounds but partaking of all other qualities of the fetal heart. I concluded that since the arterial pulse can in most cases be heard synchronously, this can be nothing else but the venous pulse rate which is audible only instead of being palpable. Long before this observation I obtained identical findings in large fibroids of the uterus. That bruits resembling uterine souffles of pregnancy are occasionally heard in fibroid uteri is mentioned in text books. Two such cases have come to my notice. While I found no more uterine bruits, I heard in most cases a rapid, rhythmic sound of low pitch but sufficiently audible and having the characteristics of the fetal heart; that is, its rapidity was about twice the rate of the maternal heart with the irregularly alternating single and double beats of the fetal heart which latter I have amply written about in 1925.[2] At times the venous sounds are so low that one only experiences a consciousness of their presence and rate.

While the venous sounds, excepting those of the uterine fibroids may be heard at the least expected part of the body, it is best heard at the anterior superior spine of the ilium, the iliac fossa, the symphysis pubis, the upper part of the coccyx, the lumbar and sacral vertebra and over the long bones of the thighs and legs; and frequently over Pourpart's ligaments. In other words, they are best heard through the medium of bones or layers of muscles or both through which the veins cannot be readily compressed and the pulsations obliterated. Examples of muscle media instrumental in facilitating the audibility of the venous circulation are the muscles over (and including) Poupart's ligaments, fibroid uterus and pregnant uterus. The heart-like pulsations of the venous circulation is caused by the flapping of the venous valves in their encounter with the stream of circulating blood. It does not mean that the sounds

can be heard with equal clarity in all the areas mentioned, and in some of these areas they may at times be entirely inaudible.

In the beginning, before your ears are attuned to pick up these low pitched tones, select patients with normal or slow pulse rates; then count the pulse and impress on your mind its rate and rhythm. Listen for the venous circulation with the mouth of the stethoscope aimed at fitting snugly against the contour of the bones (not against the flesh) in order that there might be no leakage of sound. It may take one-fourth to one-half minute for the auditory transition to take place when the low pitched rapidity of the venous pulsations supersede the higher pitched, slower, arterial pulsations. Count. The venous pulsations will be more rapid and irregularly alternating single and double beats. If both pulsations are present, two or three of the venous beats will be heard between the arterial pulsations, depending upon whether they be single or double at that moment. If in doubt whether you are hearing the venous circulation or weak arterial pulsations, count the venous pulsations and compare with the radial pulse rate. The difference will be readily ascertained. At times the venous circulation is so distinct that it will help to make further elicitations comparatively easy. If not heard readily in an environment of quietude, concentrate your audition by pricking up your ears, closing your eyes and furrow your brow; and do not forget to eliminate friction sounds often caused by stethoscope.

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Case Reports

CAVERNOUS HEMANGIOMA OF THE SPLEEN*

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HEMANGIOMA of the spleen, a relatively rare condition, was reported for the first time by Virchow in 1846. Since then, little information has been contributed to the general knowledge of this condition. For a summary of the academic aspects of this subject, the reader is referred to the article by Pines and Rabinovitch.[8]

The pathogenesis of benign hemangioma is still undetermined. A developmental anomaly in the structure of certain vascular segments may be responsible for this lesion. Matas[6] and Delafield and Prudden[2] maintain that hemangioma is composed of the same cellular elements that give rise to primordial blood vessels. In accordance with this they believe that the hemangioma is the result of disordered, spontaneous growth of these primitive cells. Why hemangiomas assume a capillary or cavernous configuration and why they occur at all is imperfectly understood.

The incidence of benign hemangioma of the spleen is approximately .1 per cent. In 1927, Krumbhaar[5] reported one case in 6,500 autopsies. Kellert,[4] in 1932, reported three cases in 1,900 autopsies and considered this a high percentage. Schottenfeld and Wolfsón[9] in 1937, cited four cases in 2,800 autopsies. In 1942, Pines and Rabinovitch[8] reported six cases of benign hemangioma of the spleen as incidental findings in 3,676 autopsies and stated that there was no clinical evidence of such a lesion. In a comprehensive review of the literature, Pines and Rabinovitch[8] reported forty-two cases of benign hemangioma of the spleen. Fifty per cent of these cases were found at operation and the other 50 per cent were incidental findings at autopsy. In 1943, Stuhlinger[10] reported a case of giant cavernous hemangioma of the spleen in which that organ weighed 4,700 Gm. The patient presented himself because of symptoms resulting from a large abdominal mass. After removal, 2 liters of bloody fluid were found in the hemangioma. In only three of the reported cases did preoperative rupture of the hemangioma necessitate splenectomy.

Haines and McIlroy,[3] in 1933, reported a case in a forty-three-year old white female who, with no history of trauma, complained of severe epigastric pain of twenty-four hours' duration, which was followed by nausea and vomiting. On

SP. 51789

FIG 1 Surface of spleen showing the rent on the diaphragmatic surface, S P. 51789

admission the patient was semicomatose and evidently in shock from blood loss. A tentative diagnosis of perforated gastric

An appendicectomy was performed although that organ appeared normal. The McBurney incision was closed and an
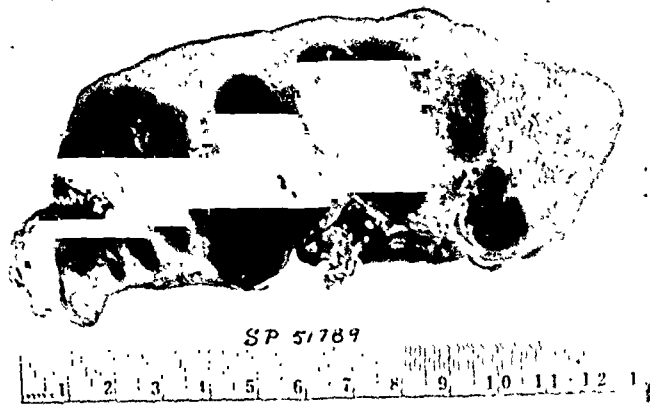

Fig. 2. Section of spleen showing the cavernous hemangioma and site rupture. S.P.,51789.

ulcer was made. Immediate operation was performed, and a spleen containing a ruptured hemangioma was removed. The patient died forty-eight hours postoperatively.

In 1939, Nesler et al.[7] reported the first case of ruptured hemangioma of the spleen successfully treated by splenectomy. The patient was a white male, age forty, admitted with severe pain localized in the left side of the upper abdomen and referred to the left shoulder. The abdomen was rigid. The patient appeared acutely ill. The white blood cell count was 16,000. Physical findings suggested a perforated gastric ulcer. Operation was immediately performed. A ruptured hemangioma of the spleen was removed. The patient had an uneventful recovery except for superficial infection of the wound.

Cole and Forsee,[1] in 1940, reported a case in a twenty-seven-year old Army officer who had sudden intermittent pain in the upper abdomen associated with vomiting. The abdomen was distended and tender throughout. The white blood cell count was 15,200 and hemoglobin was 80 per cent. A tentative diagnosis of acute appendicitis was made. The abdomen was opened through a McBurney incision and blood welled into the wound.

upper abdominal incision was made. Free blood was evacuated from the peritoneal cavity. A spleen containing a perforated hemangioma was removed. The postoperative course was uneventful.

The purpose of this paper is to add to the above reports a case of ruptured cavernous hemangioma of the spleen. It was mistakenly diagnosed as acute appendicitis and was successfully treated by splenectomy.

CASE REPORT

L. W., Chart No. 82835. A white boy, age sixteen, was admitted to the University Hospital because of generalized abdominal cramps of twenty-four hours' duration. There was no history of nausea or vomiting. Three weeks prior to admission he was hit by an automobile. He sustained abrasions of his left shoulder but this did not hinder him from working on a farm. The patient was first seen in the Accident Room with a temperature of 101°F., respirations 24, pulse 110, and blood pressure 120/80. The white blood cell count was 19,000. The urine was normal. Examination of the chest revealed dullness at the left base. The left diaphragm seemed fixed. X-ray of the chest revealed no positive findings. Severe pain and tenderness throughout the entire abdomen was noted but the tenderness was more marked in the left upper and right lower quadrants. Some rigidity with moderate muscle spasm was

present. A tentative diagnosis of acute appendicitis with early spreading peritonitis was made. Under spinal anesthesia the peritoneum was opened through a McBurney incision. The abdomen was found to contain a large amount of bright red blood. The McBurney incision was immediately closed and a left upper paramedian incision was made. Numerous small blood clots were seen floating in a pool of blood, approximately 750 cc. Upon palpation of the spleen, a large rent in the superior pole was found. (Fig. 1.) Several large blood clots were adherent to the left diaphragm. The free blood was evacuated. The liver, stomach and duodenum were found to be normal. Splenectomy was performed without drainage. The postoperative course was uneventful and the patient left the hospital sixteen days after operation.

The spleen weighed 450 Gm. and measured 16 by 11 by 7 cm. A large rent was present on the diaphragmatic surface. (Fig. 1.) Grossly, multiple hemorrhagic cysts were seen which occupied most of the splenic substance. They varied from 1 to 3 cm. in diameter. (Fig. 2.) The microscopic picture showed many large cystic vascular spaces filled with clotted blood. The cystic spaces had an endothelial lining and a definite fibrous wall. The splenic pulp was normal in appearance but displaced because of numerous angiomatous spaces.

SUMMARY

A benign hemangioma of the spleen sometimes ruptures causing hemoperitoneum and signs of an acute surgical condition of the abdomen.

Three of forty-three reported cases of hemangioma of the spleen were complicated by rupture and hemoperitoneum.

This condition, ruptured hemangioma of the spleen, has been most often diagnosed as acute appendicitis and perforated gastric ulcer.

A case of ruptured hemangioma of the spleen which was mistakenly diagnosed as acute appendicitis is reported. This patient was successfully treated by splenectomy.

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OBTURATOR HERNIA

REPORT OF AN OPERATION FOR IRREDUCIBLE INCARCERATION

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IN 1938, Watson collected 420 cases of reported obturator hernia since the first published observation of this uncommon entity by Arnaud de Ronsil in 1724. An analysis of this series showed that the hernia occurred with about equal frequency on the right and left side, and in twenty-one instances it was bilateral.

A personal review disclosed seven cases which appeared in the international literature in the past twenty years. None of these was accompanied by the complication of irreducibility which characterized the clinical findings in our patient.

Obturator hernia, as the name suggests, is an abnormal protrusion of an intra-abdominal viscus through the obturator foramen in the bony pelvis. This foramen transmits the obturator nerve and vessels, and is partially closed by a durable fascial membrane. Almost invariably it is a segment of small bowel that is found contained in the hernial sac, and this sac follows the course of the obturator nerve through the canal. In 1840, Howship described an important diagnostic sign which was later confirmed by Romberg (Howship-Romberg phenomenon). This consists of paresthesia and subjective pain from the hip downward to the knee along the antermedial aspect of the thigh. This corresponds to the anatomical distribution of the obturator nerve, and is apparently produced by pressure on the nerve from the sac and its contents in the obturator canal.

Obturator hernias occur most frequently in the thin, asthenic elderly women, who have borne many children. These conditions favor the absence of sufficient supporting fat in the retroperitoneal areas about the canal entrance. This together with attenuation of the fascial supporting structures in the pelvis, sets the stage. Precipitating factors are those which produce sudden increases in intra-abdominal pressure, i.e., coughing, sneezing or lifting.

Preoperatively, the existence of an obturator hernia may be suspected, but the diagnosis is seldom made before laparotomy. The clinical picture is one of small bowel obstruction, usually complete, with the absence of stools and flatus and with persistent vomiting. The Howship-Romberg sign was present in 16 per cent of 396 cases. Adequate study must be the rule with these patients particularly with regard to surgical preparation, for the mortality is high, 66 per cent in Watson's series.

Although two surgical routes, the abdominal and the obturator are theoretically available, the latter may be discarded in favor of a mid-line or lower rectus incision. An approach directly to the obturator foramen through an incision placed medial and inferior to the femoral canal is dangerous, and may require a supplementary laparotomy for proper exposure and successful disposition of the hernia.

CASE REPORT

Mrs. M. W. (No. 1362) a widow, age sixty-six years, was admitted to St. Elizabeth's Hospital at 1:55 P.M. on April 22nd with the complaint of severe pain in the left lower quadrant accompanied by vomiting and obstipation. A detailed history revealed that on April 18th, while attending an afternoon social gathering in the Church basement, she felt

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vaguely sick and went home to bed. Two hours later she was seized with excruciating, intermittent pains in the lower left abdominal quadrant, radiating into the thigh. A few minutes later she vomited a large amount of bile-stained fluid with considerable force. The patient tolerated this condition for three days without relief, then agreed with the family that medical consultation was advisable.

On arrival at the hospital the patient appeared acutely ill. She was extremely dehydrated, the teeth were covered with sordes, and the tongue was dry and furry. Observation disclosed a thin distended abdomen with peristaltic waves sweeping from the ensiform to the pubes. A high-pitched tinkling sound was easily audible and on percussion a resonant tympany was elicited. Physical examination exonerated the usual superficial sites (femoral-inguinal-umbilical) for bowel incarceration. Rectal examination and subsequent barium enema furnished completely negative findings. On admission the temperature was 97.6°F., pulse 84, respirations 20, blood pressure 124/70. Blood was type 0; Kline test was negative; there were 4.5 million red blood cells; hemoglobin was 97 per cent; white blood count was 18,900; there were 7 immatures and 11 lymphocytes. Five days later the red blood count was 5.1 million and the leucocytes had dropped to 7,500. Examination of the urine was normal.

Review of the family history furnished no pertinent information except to eliminate carcinoma as the cause of death in the patient's mother, father and ten siblings.

The patient stated that on December 26th, (four months prior) she experienced an attack of abdominal pain and vomiting similar to the present illness, but relatively less severe, which terminated spontaneously in twenty-four hours.

A continuous Wangensteen suction was started and fluids (5 per cent glucose with vitamin B in saline) were administered intravenously with very favorable effect on the distention and vomiting. After three days of preparation the patient was considered ready for surgery.

On April 26th, under local (0.5 per cent metycaine) anesthesia supplemented with intravenous pentothal (1.0 per cent), a lower right rectus incision was made through the thinned abdominal wall and the peritoneal cavity opened. There was no free fluid present. Due to the gastric suction, the intestines were not unduly distended and excellent visualization of the pelvis was obtained with the patient in the Trendelenburg position. The site of obstruction was easily discovered. A small loop of mid-ileum had become impacted in the left obturator canal. The bowel serosa appeared moderately injected and inspection revealed many broad sheets of tough fibrous tissue which intimately fused the involved intestine with the parietal peritoneum surrounding the obturator foramen. It appeared that this was a condition of rather long standing. Evidently the incarceration had suddenly become complete, transforming the partial obstruction into an acute emergency.

All attempts at reduction of the hernia by gentle traction were unsuccessful. Bimanual efforts, with pressure directed from outside the obturator canal also failed to release the bowel. Finding it impossible to effect reduction, it was decided to circumvent the obstruction. The afferent and efferent loops of bowel were identified and the serosa approximated by a continuous Lembert suture of fine cotton. A three-inch side-to-side entero-enterostomy was then completed. A No. 12 F. Pezzar catheter was placed in the small intestine distal to the anastamosis by a modified Stamm technic. This catheter was brought out through a separate stab incision, and was to function as a route for alimentary feedings during the convalescence. Two Gm. of sulfanilamide powder was dusted over the pelvic peritoneum and closure of the incision effected with interrupted sutures of No. 40 cotton.

The postoperative course was moderately stormy for seventy-two hours. Continuous gastric suction was required to control distention and opiates were administered to relieve the severe pelvic discomfort. On the fourth postoperative day, considerable flatus was passed and constituents of the enterostomy feedings (digested protein-dextrose-cod liver oil and soluble vitamins) were noted in the soft formed stool. Tests for urobilinogen in the feces at this time were strongly positive indicating a patent anastamosis. The incision healed by primary union and on May 1st (the fifth postoperative day) the gastric suction was removed and a soft diet administered orally. This was well tolerated by the patient

who was now pain free. On the following day
the enterostomy feeding tube was withdrawn
leaving a small fecal fistula which ceased
draining forty-eight hours later. The patient
became ambulant on May 5th and was dis-
charged from the hospital in satisfactory con-
dition on May 12th after a stay of twenty-one
days. There has been complete bowel patency
to date.

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DISRUPTION or eventration of abdominal wounds usually occurs
between the seventh and eleventh days after operation, after the use of
vertical incisions closed with catgut. Wound infection, drainage, cough or
other strain favors the disruption. After a secondary closure, a secondary
eventration may occur.

From "Principles and Practice of Surgery" by W. Wayne Babcock
(Lea & Febiger).

SPLENOSIS

INTRAPERITONEAL TRANSPLANTS FOLLOWING TRAUMATIC RUPTURE OF THE SPLEEN

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IN experimental animals splenic tissue may be readily transplanted. Von Stubenrauch[15] found on autopsy intraperitoneal transplants in dogs that had had crushed splenic pulp placed throughout the peritoneal cavity after splenectomy done three months previously. Marine and Manley[19] and later Perla[14] have successfully transplanted splenic tissue into the abdominal walls of white rats.

Were such experimental work done upon the human the results would be similar. We now know that under favorable conditions the human peritoneum has the ability to domicile as autografts fragments of splenic tissue that remain in the peritoneal cavity after traumatic rupture of the spleen. Hamrick and Bush,[5] in 1942, found in foreign literature only seven cases and in American literature three cases of multiple peritoneal transplants that had been discovered at celiotomy or at autopsy done months or years after splenectomy had been performed for traumatic splenic rupture. These, with a case of their own, make a total of eleven cases that have been reported. Buchbinder and Lipkoff[8] have suggested splenosis as a descriptive name for the condition. Gill,[7] in 1944, removed a mass of splenic tissue the size of a hen's egg from the left chest wall near the tenth rib of a negro man of fifty-two, four years after splenectomy had been done for a perforating gunshot wound of the spleen and of the diaphragm. Only diseased spleens rupture spontaneously and no case of autotransplantation has been reported following spontaneous rupture.

Von Stubenrauch,[15] in 1912, was the first to identify splenic nodules found over the peritoneum after traumatic rupture of the spleen as being autografts. Albrecht,[11] in 1896, Schilling,[19] in 1907, Von Kuttner[13] and Foltin,[12] in 1911, had reported having found similar intraperitoneal nodules which they had thought to be accessory spleens. Neither in Albrecht's case nor in Schilling's was there a history of trauma or splenectomy. To determine with certainty the origin of such nodules in patients who do not give the history of having had previous severe abdominal injury may be impossible. The number and the distribution of the nodules, however, may be suggestive. Multiplicity and wide dissemination with pelvic involvement from the effect of gravity characterize splenosis.

Accessory spleens, with rare exception, are few in number and are located within or about the splenic region in the left upper abdomen. They are miniature spleens of identical shape and structure as the parent organ with hilum, capsule, trabeculae, follicles and pulp. Grafts, on the other hand, vary in size and shape. They are often sessile but may be pedunculated. They have no hilum and blood vessels enter anywhere along the periphery. The parenchymatous structure is that of splenic pulp. Trabeculae are deficient and irregularly placed. Follicles occur only as they have survived as integral parts of the fragments of splenic tissue from which the grafts have sprung.

Accessory spleens are not rare. In a series of autopsy examinations done upon subjects of all age groups Adami and Nichols[17] found accessory spleens in 11 per cent. Jolly[16] found the autopsy incidence in children under seven to be 25 per cent and Sassuchin[18] in those under ten years to be 15 per cent. Congenital

anomalies are apt to be multiple and the increased autopsy incidence of accessory spleens in young children may be due to a

spleen shrinks to one-fourth its original size.

Severe trauma may cause immediate

FIG. 1. Splenic transplant consisting of pulp with rudimentary follicle (A) and trabeculae (B), (low power).

greater mortality rate in them from associated developmental errors.

Although well protected from trauma by position, the spleen is the most vulnerable of the abdominal viscera to the application of blunt force. The fact that it is a highly vascular lymphoid organ of reticulo endothelial structure with large communicating spaces makes it peculiarly susceptible to injury. A storage place for blood, it undergoes rhythmic contractions from the action of involuntary muscle fibers in the capsule and in the trabeculae. With the abdomen opened the blood volume just before splenectomy may be materially reduced by the administration of adrenalin. In the cat after death the

rupture of the spleen with tearing of the capsule and exsanguinating intraperitoneal hemorrhage. Laceration of the friable splenic pulp from trauma of less degree, however, is followed by hemorrhage into the gland that may not cause rupture of the capsule from tension for a week or more after injury. Massive intraperitoneal hemorrhage may follow such delayed rupture of the capsule. Oneill and Rousseau[6] describe three types of bleeding occurring after traumatic injury to the spleen: (1) Extensive rupture with immediate massive hemorrhage; (2) small lacerations which ooze blood slowly over a period of hours or possibly days; and (3) delayed splenic rupture.

In the first and in the last of these classes at splenectomy, which is the only effective treatment, the diagnosis may be confirmed. In Class 2, however, the diagnosis remains uncertain for these patients are not subjected to operation. After abdominal injury pain referred to the left shoulder from irritation of the phrenic nerve may be from extravasated blood and suggests but is not pathognomonic of splenic rupture.

No one knows how many of us as children have had injuries to the spleen from trauma that did not require bed rest and was soon forgotten. Injury of this degree is probably more frequent than has been supposed. Spontaneous control of hemorrhage after rupture is possible. Babcock[10] states that hemorrhage into the abdominal cavity from injuries to the spleen may be partly, temporarily or permanently arrested by adhesion of coagula or omentum over the splenic wound (tamponade). If we accept the validity of this, we may no longer be sure that many of the so-called accessory spleens are not transplants. Although the question of origin is of academic rather than of practical interest, the burden of proof in doubtful cases may well be upon the advocates of accessory spleen.

In a review of 25,000 necropsies done at the University of Minnesota, J. S. McCartney found no case of healed splenic hematoma and Roettig et al.[1] of the Ohio State University say that such a spontaneous cure rarely if ever occurs. Since having become interested in a case of primary tuberculosis of the spleen with areas of calcification from healed tubercles we have seen a number of roentgenograms of non-tuberculous spleens in which similar shadows were thought to have been the remains of healed hemorrhagic infarcts. Infarction of the spleen is not rare and is described in text books. It is impossible to distinguish at autopsy a hematoma that has healed after trauma from one healed after infarction. A hematoma of either kind may heal with calcification.

It should be remembered that such nodules, whether congenital or acquired, possess the qualities of normally placed splenic tissue and that systemic disease resulting from splenic dysfunction may recur after splenectomy if the nodules are not surgically removed. In congenital hemolytic icterus and in thrombopenic purpura recurrence of symptoms after splenectomy are an indication for exploratory celiotomy in the attempt to find and to remove such nodules. Curtis[2] reports the case of a child of four having primary splenectomy successfully done by him during an attack of hemoclastic crisis. Return of clinical symptoms and of characteristic blood findings after four years were again followed by improvement after he removed two small accessory spleens at exploratory laparotomy.

CASE REPORT

R. B., age twelve, was admitted December 21, 1943, in an acute attack of recurrent appendicitis. At appendectomy done through a McBurney incision there were found perhaps a hundred dark bluish red parenchymatous nodules attached to the retroperitoneum, the mesentery and the great omentum. They were not pedunculated and were of irregular shape. Some were as large as acorns, others as small as peas. Several were found in the pelvis. The left abdomen and the splenic region could not be visualized. They were obviously glands of some kind, enlarged hemolymph glands, accessory spleens or autografts of splenic tissue. On section the tissue macroscopically was splenic pulp. The distribution was not that of accessory spleens. Following a fall three years previously, the boy had had splenectomy done by Dr. George Benet for traumatic rupture of the spleen with massive intraperitoneal hemorrhage. Convalescence had been uneventful and he had remained well except for recently recurring attacks of appendicitis. Since appendectomy he has been in good health.

Microscopical examination of a nodule removed by biopsy showed it consisted of splenic pulp with a peritoneal covering. This is without a doubt a case of autotransplantation following traumatic rupture of the spleen with wide dissemination throughout the abdomen of small fragments of splenic tissue by extrava-

sated blood. The condition in this patient was symptomless and of no clinical significance. We report this, the twelfth case of its kind, because of its rarity.

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SEPTICAEMIA and Bacteriaemia are due to the presence of organisms in the blood. In the former condition the organisms are not only present in the circulation, but actually proliferate therein.

From "A Short Practice of Surgery" by Hamilton Bailey and R. J. McNeill Love (H. K. Lewis & Co. Ltd.).

MEDIASTINAL EMPHYSEMA

REPORT OF THREE CASES SECONDARY TO NECK OPERATIONS

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THAT mediastinal emphysema should frequently follow surgical procedures on the neck is a logical conclusion if one considers the relation of the cervical fascial spaces to the mediastinum and the mechanics of breathing. A review of the literature does not support this conclusion. The purpose of this paper is to report three cases of mediastinal emphysema following neck operations and to suggest that the complication is much more frequent than reports indicate.

LITERATURE

Mediastinal emphysema has been recorded occasionally following thyroidectomy, more often following tracheotomy for laryngeal obstruction, and only rarely following all other procedures in the cervical region. Mediastinal emphysema was not mentioned as a complication of 21,869 thyroidectomies reviewed in reports by Dobson, Seely and Rose,[1] Adams,[2] Grace and Weeks,[3] Glenn,[4] Cochran,[5] McQuillan and Breidenbach,[6] Lahey,[7] and Spear.[8] Eighteen cases of mediastinal emphysema following thyroidectomy were reported in papers of Buford,[9] Gold,[10] Keis,[11] Barrie,[12] and Herman.[13] These included individual cases and seven cases collected from the literature. The rate of the complication was not stated in any of the reports. Fifty-two cases following tracheotomy for laryngeal obstruction were reported by Neffson.[14] Michaels,[15] Goldberg,[16] Work,[17] Schmidt.[18] and Barrie,[12] thirty of which complicated 126 tracheotomies for laryngeal obstruction in Goldberg's report. The three cases reported following other neck procedures include a tuberculous gland dissection (Buford[9]), a jugular vein ligation (Schmidt[18]), and a block dissection of the neck (Ackerman[19]).

COMMENT

Recent discussions of spontaneous and secondary mediastinal emphysema by Hamman[20] and by Schwartz, McIlroy, and Warren[21] stressed the spontaneous type. However, operations that open up the fascial spaces of the neck with their direct communication to the mediastinum offer an ideal condition for the force of inspiration to suck air into the mediastinum. Any struggle during anesthesia increases this force. Any obstruction to the normal air passages transfers the effective force of inspiration from the normal air passages to the opening into the mediastinum made by the surgeon.[17]

The presence of mediastinal emphysema is detected by finding over the precordium bubbling crepitations synchronous with each heartbeat, which sounds may be present in only certain positions of the patient. When once heard they are confused with no other sound. Pain similar to the pain of angina may be present or absent. Roentgenograms at times disclose the gas around the heart shadow and often pneumothorax, which is a common accompaniment. In severe cases there is respiratory difficulty and signs of cardiac tamponade.[20]

Asymptomatic cases require no treatment. Rest, reassurance, and analgesics suffice in mild cases.[22] Oxygen is indicated in cases with respiratory difficulty.[9] Patients with severe cases need the air evacuated from the mediastinum, which evacuation has been accomplished by aspiration[23,24] or by incising the base of the neck to allow the trapped air to escape.[25,26] One patient in extremis was saved by the heroic measure of splitting the sternum.[20] The free airway which intratracheal anesthesia affords is good prophylaxis.[27] Local

anesthesia obliviates any struggle from anesthetic induction or faulty anesthetic technic. In operating upon the neck it is well to keep moist gauze in the lower end of the wound to seal off the neck spaces from the mediastinum.[19]

Whereas the cases reported previously have been severe, often resulting in death, the cases in the present report have been mild.

CASE REPORTS

CASE I. A twenty-seven year-old white male was admitted March 30, 1943, for dizziness, precordial pain, and palpitation present since September, 1942. Physical examination showed an enlarged right lobe of the thyroid with no roentgenologic evidence of a substernal mass. There was no evidence of toxicity. On April 9, 1942, the right lobe of the thyroid was removed under inhalation anesthesia. The induction was smooth and at no time was there respiratory distress or cyanosis. Difficulty was encountered, however, in freeing the gland posteriorally and from the trachea. All bleeding was controlled and the wound closed without drainage. The patient tolerated the operation with very little change in pulse or blood pressure. Several hours after his return to the ward the patient complained bitterly of severe precordial pain with radiation down the left arm. Physical examination was normal except for precordial bubbling crepitations synchronous with each heartbeat. Roentgenogram showed subcutaneous emphysema in the neck and mediastinal emphysema. There was no pneumothorax. Morphine subcutaneously and reassurance relieved the symptoms in a few minutes. The remainder of the convalescence was uneventful. No signs of mediastinal emphysema could be found after the third postoperative day.

Note. Nineteen thyroidectomies have been done in this hospital since February, 1943, and in only the above case was any evidence of mediastinal emphysema found. The diagnosis was quite important in this case, especially since the patient came to the hospital complaining of precordial distress.

CASE II. A thirty-two year-old white male was admitted October 17, 1943, with a self-inflicted knife wound of the anterior neck penetrating the thyroid cartilage. A tracheotomy tube having been placed in the incised trachea and bleeding having been controlled by suture of the wound by the local medical officer, the condition on admission was excellent with no respiratory distress and no shock. Blood pressure was 160/100; pulse was strong and slow; the heart and lungs were normal. Under cervical plexus block and local anesthesia the wound was thoroughly cleansed, bleeding controlled, tracheotomy done, and the wound repaired with cotton sutures. The patient was quiet and in good condition throughout the procedure. The night after admission the tracheotomy tube, which was too short for the patient, came out of the trachea. The next day subcutaneous emphysema was found around the tracheotomy opening, and bubbling crepitations synchronous with each heartbeat were heard over the precordium. A larger tracheotomy tube was inserted under local anesthesia. By the fourth postoperative day there was no evidence of mediastinal emphysema. The patient's further convalescence was uneventful, the tracheotomy tube being removed on the sixth postoperative day.

Note. The asymptomatic mildness of the mediastinal emphysema called for no treatment except insertion of a larger tracheotomy tube.

CASE III. A twenty-seven year-old white male was admitted on April 23, 1945, following an explosion in which he received multiple wounds. The most severe laceration was the one in the left supraclavicular region. After shock treatment and under cervical plexus block the wound was enlarged and the clavicular head of the sternocleidomastoid muscle was transected. The internal jugular vein was dissected free, and a piece of jagged metal about an inch across was found lodged in the base of the neck. Bleeding was controlled by fingers placed over the internal jugular vein at its junction with the subclavin. On releasing the finger the wound became filled with blood and milky white chyle. This was evidence that the main lesion was behind the clavicle, so that inhalation anesthesia was started. During induction the patient strained and coughed and became cyanotic, having evidently developed a laryngeal spasm. Sucking sounds were heard around the vessels of the neck when the

patient attempted to inspire against the closed glottis. To facilitate the exposure, the clavicle was severed with a Gigli saw and the medial fragment mobilized. There was a large tear about an inch long at the junction of the internal jugular and subclavian veins on the lateral aspect. The thoracic duct was visualized and appeared uninjured. The vein was repaired with cotton sutures and the wound closed in layers after wiring the clavicle. Immediately after the operation bubbling crepitations synchronous with each heartbeat were heard over the precordium. The patient was heparinized and given sulfadiazine and penicillin. He had a rather stormy postoperative course, developing a cloudy effusion of his left chest which was aspirated and penicillin injected. This fluid was negative for fat. The third day after the accident no signs of mediastinal emphysema were found. The patient's symptoms and signs all subsided and he became well. His fractured clavicle was treated by a T-splint. On June 18th he had remained symptom-free for several weeks and was being kept in the hospital for his fractured clavicle. At no time did his mediastinal emphysema give him any distress. He never developed evidence of pneumothorax.

Note. As this mediastinal emphysema was asymptomatic and mild, no treatment was required for this condition. During the induction of the anesthesia when the patient strained with his internal jugular vein dissected out, the remark was made that mediastinal emphysema would probably develop.

SUMMARY

1. In two years three cases of mediastinal emphysema following neck operations have been found in one air force regional station hospital where these operations are relatively infrequent. This suggests that the complication is more prevalent than previous reports indicate.

2. The cases were all mild, which is also a marked contrast to cases in other reports.

3. Routine auscultation of the precordium following surgical procedures on the neck will surely bring to light many more incidents of this entity.

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To increase exposure, especially in the upper abdomen, a transverse incision may be made through the skin and anterior and posterior sheaths of the rectus muscle at right angles to a median incision. This type of exposure may be indicated in certain operations upon the gall-bladder, stomach, pancreas, spleen, and transverse colon.

From "Operations of General Surgery" by Thomas G. Orr (W. B. Saunders Company).

VOLVULUS OF THE SIGMOID COLON*

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VOLVULUS of the sigmoid is an infrequent but often spectacular cause of acute or intermittent intestinal obstruction. Sweet[1] found that fifty-three of 540 cases of acute intestinal obstruction were due to volvulus and of these, thirty-six involved the small intestine, ten the sigmoid, and six the cecum. In Central European countries[2] the relative incidence is much greater than in America; in Russia volvulus ·has been reported in as high as fifty per cent of acute intestinal obstructions. This greater incidence has been explained by the more bulky vegetable diets of these peoples.

The present case is reported because of several unusual features.

CASE REPORT

The patient was a twenty-year old soldier of Polish and Hungarian parentage. The diet had not been unusual in quantity or type of food, and the bowel habits were regular without the use of laxatives.

The earliest symptoms were noted about a year prior to the present admission when there. was an attack of intermittent, cramp-like, low back pain which lasted several hours. Abdominal symptoms were not present and there was no radiation of the pain. In the year following there were six or seven such attacks, some of which were associated with abdominal cramps, and most of which were accompanied by a painful desire to defecate. On January 29, 1945, there was an episode of low abdominal cramps which again were associated with a desire to defecate. This was relieved by magnesium sulfate and the passage of a well formed stool. The bowel movements during the next ten days were frequent but consisted only of small amounts of yellow mucus and

some flatus. On February 9, 1945, he was awakened by severe intermittent pain in the low back, localized over the sacrum. This pain did not radiate to the abdomen or elsewhere, but there was again the urge to defecate and vomiting of a small amount of greenish material.

On admission the patient was obviously in marked distress. Examination of the back revealed nothing abnormal, there was no objective tenderness or muscle spasm. The abdomen was full but not distended or tense. Abdominal tenderness and muscle resistance were completely absent. No masses were palpable and peristaltic sounds were of normal intensity. Rectal examination revealed no tenderness but a peculiar soft wall of resistance was encountered superiorly. Sigmoidoscopic examination for a distance of 25 cm. revealed an empty bowel of normal appearance. The leucocytes numbered 14,750 with 84 per cent neutrophiles and 11 per cent lymphocytes; the temperature was 99°F. Roentgenograms of the abdomen (Fig. 1) revealed a tremendously dilated loop of large bowel which occupied most of the mid-abdomen: the septa were greatly exaggerated. The remaining large bowel, including the cecum, was not distended and the small intestine was not visualized. In the erect position (Fig. 2) a fluid level was evident within the dilated loop. Volvulus was suspected and its location in the sigmoid was demonstrated by a small barium enema. (Fig. 3.)

Immediate exploration was performed through a left rectus incision. The greatly dilated loop of sigmoid presented in the wound. It filled the entire left and part of the right abdomen and possessed a wide, fan-shaped portion of mesentery 11.5 cm. in length and 6.5 cm. across its base. Torsion of 360 degrees had resulted in almost complete obstruction at both the proximal and distal ends of the loop. The bowel was moderately dusky in

color but viable; it was deflated through a previously inserted rectal tube, then delivered and rotated in a clockwise direction to restore

obstruction and interference with the mesenteric blood supply, hence distention of the isolated loop is usually rapid. This
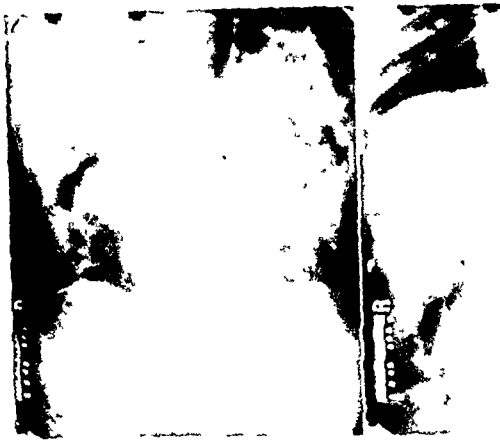

FIG. 1.   FIG. 2.   FIG. 3.

FIG. 1. Roentgenogram of volvulus of the sigmoid showing tremendously dilated loop of colon.

FIG. 2. Volvulus of the sigmoid in erect position, a fluid level is apparent in a dilated pelvic loop of colon.

FIG. 3. Roentgenologic appearance pathognomonic of volvulus of sigmoid, the barium enema reveals rapid tapering of the rectum to a constriction with torsion of rugal folds with a tremendously dilated loop of sigmoid above it.

its normal relationship. A Rankin obstructive resection of the redundant loop was performed. The convalescence was uneventful except for atelectasis of the right lung which became apparent on the fourth day and promptly responded to postural drainage and medical management. The colostomy was closed May 22, 1945.

The specimen (Fig. 4) consisted of a hugely dilated segment of sigmoid 15 cm. in diameter and 71 cm. along its anti-mesenteric border. It was attached to a widened, fan-shaped segment of mesentery. No intrinsic obstruction was found. The mucosal folds were obliterated, the bowel wall greatly thinned, and large septa were present.

COMMENT

This case is of interest because of the presenting complaint of backache without abdominal pain, tenderness or distention, The ineffectual urge to defecate was the most significant and only localizing symptom, and it suggested a diagnosis of high prolapse of the rectum, pedunculated tumor of the rectosigmoid, or volvulus of the sigmoid colon. Roentgenograms were typical of volvulus of the sigmoid colon. Volvulus produces a closed loop type of

contrasts with the more general distention of the proximal colon and cecum characteristic of simple obstruction of the sigmoid such as results from malignant lesions. Roentgen studies with the barium enema

FIG. 4. Specimen removed from volvulus of sigmoid; megacolon with widened mesentery.

demonstrated a twisting spiral pattern in the rugal folds with rapid filling of the dilated loop above the obstruction. In this instance reduction of the volvulus did not occur during examination as sometimes happens. The interference with the

circulation resulted early in a relatively quiet abdomen. The history of this patient suggests that episodes of partial or temporary obstruction had occurred at intervals for a year before complete obstruction led to surgery. The localized redundancy of the sigmoid mesentery was an essential prerequisite to the production of the volvulus and probably was a congenital anomaly. In addition to the dilatation there was also actual hypertrophy of the involved segment of colon, which was either congenital in origin or secondary to the repeated episodes of chronic intermittent obstruction, or the result of both of these factors.

When volvulus is diagnosed immediate surgical intervention is indicated. Preoperative preparation other than essential intravenous fluids only results in unjustified delay which often permits the development of gangrene and peritonitis.

Attempted deflation of the distended loop by intubation is futile since the obstruction is of the closed loop type. When strangulation and gangrene are demonstrated at exploration, removal of the damaged gut is imperative. Early, before extensive vascular damage has developed, simple untwisting of the volvulus will not prevent recurrences because the redundant loop with its long narrow pedicle of mesentery remains uncorrected. The Rankin obstructive resection is admirably suited to any of these situations because it is easily and quickly performed and is attended by a reasonably low mortality even in seriously ill patients.

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RUPTURE OF THE DEEP EPIGASTRIC VESSELS

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SO-CALLED "spontaneous" rupture of the deep epigastric vessels, while not a common accident, is such a dramatic entity and is of sufficient diagnostic importance that it must always be borne in mind. This is cause sufficient to warrant the report of two cases. Observations and deductions based on two cases cannot be conclusive, but are so opposed to the trite handed-down concepts, as to justify a modern rationalization of the etiology and basis of symptoms.

CASE REPORTS

CASE I. No. 17101, G. T., age forty, a white female, was admitted to St. Joseph's Hospital, April 20, 1938, at 3 A.M., with a chief complaint of severe right-sided abdominal pain. Four hours previous to admission while taking her usual reducing exercises of bending over and touching the floor, she was suddenly seized with severe, agonizing pain. It was not accompanied by nausea or vomiting.

She had had the usual diseases of childhood. She had had two previous abdominal sections, an appendectomy in 1919, and a cholecystectomy in 1929.

Physical examination disclosed a stout, middle aged woman rolling around in bed obviously in severe pain. Examination was essentially negative except for the abdomen, which was tender throughout, much more marked on the right side. There was board-like rigidity of the right side, and very marked splinting of the left side. The white blood count was 16,100 and the red blood count was 4,100,000. The temperature was normal.

Preoperative diagnosis: Pelvic inflammatory disease with intestinal obstruction.

At operation a lower right rectus incision was made. On splitting the rectus muscle, large clots were evacuated from the hematoma coming from the ruptured epigastric vessels. Both the artery and vein were torn. The clots were evacuated the bleeding points ligated. The peritoneum was opened for exploration.

The viscera were normal. Adhesions from previous operations were encountered and separated. The wound was closed in layers. One piece of iodoform gauze was used for drainage. Convalescence was uneventful and the patient was discharged from the hospital on the tenth postoperative day.

CASE II. No. 35896. M. D., age 59, a white female, was admitted to St. Joseph's Hospital, January 16, 1943. Her chief complaint was pain in the lower left quadrant. On the day of admission following a severe paroxysm of coughing she suddenly developed severe pain in the lower left quadrant. The pain became excruciating but was not accompanied by vomiting. Her symptoms became progressively worse, accompanied by shock. She was admitted to the hospital apparently acutely ill.

She had had no previous operations and remembered no serious illness.

Physical examination revealed the patient to be a thin emaciated adult, acutely ill, in severe pain. Examination was essentially negative except for the abdomen. There was marked rigidity and exquisite tenderness of the entire left side. There was a palpable mass, the size of a large grapefruit, in the lower left quadrant. Her white blood count was 13,400 and red blood count 3,500,000. Her temperature was normal.

Preoperative diagnosis: Carcinoma of the colon with perforation.

Under spinal anesthesia the abdomen was opened by a lower rectus incision. On opening the sheath of the rectus muscle a large hematoma was encountered coming from the deep epigastric vessels. Both the artery and vein had been torn apart. The hematoma had dissected its way beneath the symphysis pubis. The vessels were ligated and the clots evacuated. The peritoneum was opened and the exploration was negative. The wound was closed in layers with one small piece of packing for drainage.

"Spontaneous rupture," "epigastric apoplexy," and "idiopathic rupture" are

misnomers. There is a definite cause if careful attention is given to the history (Case I—exercising; Case II—coughing).

Incidence. No statistics based on a given number of hospital admissions was found in the literature. Richardson reported the first case in this country in 1857. Payne states that from 1928 to 1938, 165 cases have been reported and he estimates that twice that number were not reported. Therefore, while not common, it could not be called a rare disease.

Anatomy. Max Brödel has made a masterful contribution on the anatomy. The rectus muscle with its long narrow belly is really made up of separate muscles that act as one, because of the tendinous bands that run transversely. It can contract and expand as much as nine-finger breadths. Terrific pressure is developed when the body is raised from the horizontal to the sitting posture (Case I) and in coughing or the act of defecation (Case II). Coursing beneath this muscle from the femoral artery below, and the internal mammary artery above, this longest anastomosis in the body is fed by large caliber vessels with a relatively high pressure. The vessels lie free in loose areolar tissue separated from the abdominal cavity by peritoneum and thin fascia. They are attached, however, to the muscle by branches and are closely adherent at tendinous inscriptions.

Pathology. The rupture of the epigastric vessels usually occurs low down in the sheath below the fold of Douglas (both cases). The older descriptions divide it into an "acute" or "chronic" affair depending upon the rapidity of the progress. They speak of arterial bleeding and of venous source. In my two patients both the artery and vein were torn asunder with rapid massive hemorrhage. It is easily conceivable that with the same etiology lesser tears could occur with injury to only the vein or artery and the symptoms would be directly proportional to the amount and extent of the extravasated blood.

Etiology. In both instances there was alternate relaxation and violent contraction of the rectus muscle with a rapid and relatively enormous change in the size of that muscle. The vessels tightly bound and an integral part of the muscle at intervals, and loose in between, simply are unable to accommodate to the changing condition and were torn apart by the crack-of-the-whip action. The old accounts still speak of atheromatous vessels and debiliated disease such as typhoid. This of course, I cannot subscribe to. The frequent reports of occurrence in pregnancy and whooping cough would, however, lend weight to my conception. Likewise, the frequent occurrence of "right rectus strain" in boys training at parachute school bears out the etiological factor.

Symptomatology and Physical Signs. The onset is sudden with severe pain and exquisite tenderness in the abdomen. While previous descriptions all mention nausea and vomiting as symptoms, they were conspicuous by their absence in both cases, and that factor alone should have been a warning against an intraperioneal lesion. Prostration and shock are prominent and pronounced. The leukocyte count was moderately increased; fever was not present.

A palpable mass may be present (Case II) limited to the rectus muscle, but muscle guarding and rigidity may make it impossible to palpate until the patient is under anesthesia (Case I). Ecchymosis of the abdomen is reported having been present but did not occur in the patients observed, and would require an injury to the anterior sheath of the rectus which is most unlikely. I consider it unreliable.

Forthergill's sign depends on being able to feel a palpable mass which is still present when the patient sits up, and this mass cannot be moved from side to side. While this would be relatively conclusive evidence, it would be very difficult to elicit as an early symptom.

Diagnosis. I failed to diagnose both cases. In retrospection this was inexcusable.

The differential diagnosis is easy. A patient seized with severe one-sided abdominal pain following exertion that places strain on the rectus muscle, accompanied by shock, marked rigidity and exquisite tenderness limited to one side, not accompanied by nausea or vomiting, with or without a palpable mass will forever bring to my mind the possibility of ruptured epigastric vessels. Once the possibility is considered there is little likelihood of error and sufficient has been accomplished.

Treatment. Surgery offers the only treatment: incision, evacuation of the clots, ligation of the vessels and placing of a small drain. The peritoneal cavity need not be opened, but there is no contradiction to so doing if one wishes to explore.

CONCLUSION

Two cases of rupture of the deep epigastric vessels are reported. The injury is not "spontaneous" but follows a definite muscular action. This fact could be important from a medicolegal or industrial standpoint. A logical theory based on atomical and mechanical facts is presented to explain why the deep epigastric vessels are subject to rupture. In civilian life, the preoperative diagnosis has seldom been made. The cardinal signs and symptoms have been presented. If the entity is borne in mind, careful observation and logical deductions will readily make the diagnosis.

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DESMOID OF THE ANTERIOR CHEST WALL

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DESMOIDS or fibromas are · infrequently occurring tumors of the musculofascial structures usually appearing on the anterior abdominal wall. Their presence at other sites has been noted although their appearance elsewhere than upon the abdominal wall is distinctly in the minority. Pearman and Mayo have reviewed the literature rather carefully and have reported the details of seventy-seven patients with desmoids who were treated at the Mayo Clinic. In twenty-two instances in their series, the tumor was located in the skeletal muscle system removed from the anterior abdominal wall. The incidence in females in these twenty-two cases was greater than that among males, as is usual with this particular tumor at any site.

The casual factors underlying the appearance of these tumors are unknown. However, a history of trauma is frequently obtained and was noted in 60 per cent of the seventy-seven cases reported by Pearman and Mayo.

The pathologic characteristics of these tumors are somewhat reminiscent of a leiomyoma of the uterus. The structure is tough, grates under the knife and the cut surface bulges. The interlacing bundles are clearly visual to gross inspection. The histologic structure is that of a rather cellular fibroma which is not encapsulated. The surrounding and infiltrated muscle fibers are attenuated and foreign body-like giant cells of muscular origin are visible.

The tumors do not undergo metastasis. They may, however, recur locally if incompletely removed.

The patient whose case report follows is of interest because he is a male, a definite history of trauma was present, and the tumor was found in the upper anterior portion of the chest wall intimately connected with the pectoralis major muscle.

CASE REPORT

The patient is a twenty-three year old white male who incurred a wound of the right thorax from a shell fragment. He suffered a fracture of the right humerus, a laceration of the right lung and a fracture of the right coracoid process. Several thoracenteses were done and later a thoracotomy with removal of the foreign body was performed. Two months after injury, the patient noted a small mass in the right infraclavicular region. Gradual growth was noted. The mass was tender and pain at the site of the tumor was noted upon exercise.

Physical examination was not noteworthy with the exception of the presence of the tumor. A firm, rounded mass measuring about 5 by 3 cm. was found in the right infraclavicular region over the first rib. (Fig. 1.) The skin was freely movable over the tumor which was firmly attached to the deeper structures. Other tumors were not found during the examination.

Various laboratory procedures including determinations of the blood calcium, phosphorus and phosphotase were done as we felt a tumor of bony origin might be present. These determinations were all found to be within normal limits. Likewise the roentgenograms of the chest and the skeleton did not reveal a bone tumor or tumors to be present. We were thus confronted with a firm tumor apparently not of osseous origin but which was firmly attached to the deep structures in the right infraclavicular area.

Photographs of the patient using the infra-red technic did not show any dilated venous channels about the tumor. Some idea as to the depth to which the mass extended was obtained from a phlebogram of the right upper extremity. Twenty-five cc. of diodrast were injected into a vein in the lower right forearm with a tourniquet about the mid-arm. A pressure of 30 mm. of mercury was maintained during the injection. A visualization of the right brachial, subclavian and innominate veins was obtained

and no perceptible deviation from the normal in size or position of these blood vessels was noted.

Fig. 1. Right infraclavicular tumor.

Surgical exploration was the next procedure as all attempts to establish a diagnosis were without avail. A curvilinear incision over the tumor was made. The mass was of firm fibrous consistency without definite encapsulation, infiltrating the pectoralis major muscle and firmly attached to the fibrous tissue over the sternoclavicular joint. A wide block resection of the tumor and adjacent muscle was done.

The postoperative period was without incident. The wound healed quickly and firmly.

The tumor was 5 cm. in diameter and upon cut section presented a mass of coarsely reticulated fibrous tissue flecked with yellowish areas. (Fig. 2.) The peripheral portions of the tumor were hemorrhagic and stained yellowish-brown.

Microscopically, the specimen consisted of a mass of intermingled broad connective tissue fibers among which were numerous capillaries and foreign body giant cells. Infiltration of the
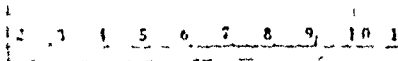
Fig. 2. Cross-section of the tumor.

surrounding muscle by the connective tissues fibers was noted. Numerous areas of hemorrhage and foreign body giant cells were seen at the periphery of the lesion. The intermingling of the fibrous core, the giant cell reaction and the apparent infiltrative character of the tumor classified it as a desmoid.

SUMMARY

The tumor is of interest for several reasons. It occurs in males but in a minority of cases. Likewise it usually is found in connection with the musculo-aponeurotic structures of the anterior abdominal wall and only occasionally in other sites. A definite history of trauma was obtained from the patient which gives further support to the theory of traumatic origin in connection with individual predisposition as a cause for the appearance of these tumors.

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OSTEOID OSTEOMA

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OSTEOID osteoma is a relatively new entity, the original article by Jaffe[1] first describing this condition appearing in 1935. Since then a later article by Jaffe and Lichtenstein,[2] in 1940, and another by Lewis,[3] in 1944, have come to the attention of the authors.

Jaffe and Lichtenstein report thirty-three cases, with rather wide skeletal distribution, exclusive of ribs, innominate bones and skull. Lewis, in his series of eleven cases, nine proved and two which he believes fall into this classification, reports one case of proved osteoid osteoma occurring in an innominate bone (right ilium).

The lesion is a small benign slowly growing osteogenic tumor, composed of osteoid tissue which later becomes calcified and converted into hypercalcified atypical bone. This nidus characteristically produces an excessive bone reaction about it so that, as it progresses, this sclerotic new bone formation may obscure the nidus on the roentgenogram. The true nature of the condition can be brought out by overexposing the film as was done in our case.

The usual history is that of localized pain, mild at the start, worse at night, which becomes increasingly severe and may in time interfere with sleep. Local swelling may also be noticed. Limp, stiffness and weakness may also be present. A history of antecedent trauma is not common.

Findings on examination consist of local tenderness, swelling, limp and sometimes muscle atrophy. Local heat, redness and fever are absent. In our case there was a very definite tendency for the patient to protect the affected part against even slight trauma.

A differential diagnosis must be made between bone abscess and chronic osteomyelitis, the most frequent diagnosis being "chronic sclerosing non-suppurative osteomyelitis." It has also been diagnosed osteoma, syphilitic osteoperiostitis and sclerosing osteogenic sarcoma.

We believe that while the diagnosis is usually made on the roentgenogram the condition should be suspected clinically when the patient is a young adult presenting localized bone pain of some months' duration. There may or may not be a palpable tumor mass of bony consistency. The lack of local heat or redness and of systemic findings of infection as demonstrated by fever, abnormal blood count and increased sedimentation rate, should bring this condition to mind.

We present the following case with characteristic roentgenogram, as we believe the condition is not commonly recognized and because this benign tumor is most frequently seen in the type of young adult with whom we in the army have to deal.

CASE REPORT

A white male, age twenty-seven, was admitted to this hospital, November 7, 1944, complaining of pain in the right forearm. His history was that in February, 1943, after a very minor injury to his right forearm for which he did not seek medical advice, he developed occasional attacks of local pain which would occur about twice a month. This pain could be induced by relatively minor local injury such as hitting his arm against an object. In October, 1943, at a Station Hospital in the States an x-ray was taken. The patient was told he had a small bone tumor. No surgery was recommended and he was allowed to proceed overseas. Since that time the patient stated the local pain had become more frequent and more severe and occasionally interfered with sleep. He unconsciously found himself

guarding his arm against contact with objects. He had noticed swelling over the forearm, and tenderness on pressure but no local heat. He
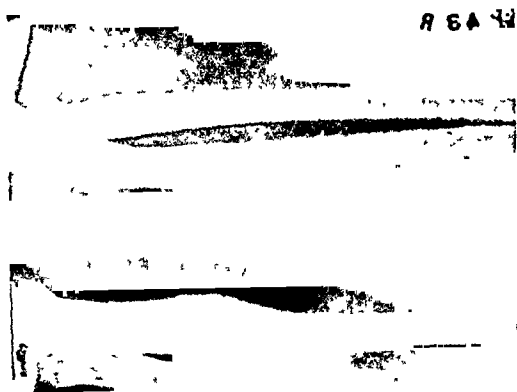

Fig. 1. Preoperative picture showing osteoma of ulna with nidus in center.

did not remember having any unexplained temperature rises.

Examination showed a hard bony tumor mass, which appeared to arise from the middle third of the right ulna. This was exquisitely tender on pressure. There was no local heat, redness or muscle atrophy present. Laboratory findings were completely negative and there was no fever.

A roentgenogram (Fig. 1) taken November 18, 1944, showed an area of bone production and sclerosis surrounding a translucent area in the cortex of the ulna on the posteromedial aspect. This was diagnosed an osteoid osteoma.

Operation was performed on November 25, 1944, at which time the tumor was removed along with cortical bone down to the medullary cavity. The nidus was not identified as such. All removed bone fragments were sent to a neighboring laboratory for examination, as our

hospital is not equipped to do bone pathological examinations. Unfortunately only two of the many bone fragments were examined and the

Fig. 2. Postoperative picture showing removal of nidus.

pathological diagnosis was osteoma. It is our opinion that the tissue examined was the perinidal sclerotic bone produced by the osteoid osteoma.

The patient made an uneventful recovery. A roentgenogram (Fig. 2) taken January 26, 1945, showed no evidence of recurrence. The patient feels well and has been relieved of his symptoms. He is back on active duty.

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Bookshelf Browsing

OLIVER WENDELL HOLMES

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OLIVER Wendell Holmes is immortal in American literature and renowned also in the annals of medical history. Few have attained his mark as a physician and poet. His life is one to be admired because of its contributions to the cause of humanity and to the esthetic enjoyments of peoples. His sincerity, honesty, and goodness could leave no man more secure in the hope for a peaceful rest under the eyes of God as the shadows of life grow longer.

Born in August of 1809 in Cambridge, Massachusetts, Oliver Wendell Holmes was the son of the Reverend Abiel Holmes, a Calvinist preacher.[1,21] His mother was Sarah Wendell, a descendent of Governor Simon Bradstreet and of the Puritan poetess, Anne Bradstreet.[6,9] A great believer in ancestry and proud of his descent from the colonial notables, Holmes was reared in an atmosphere of books and culture. It was at a very early age that he started to write poetry.

In 1824, at the age of fifteen, he attended Phillips Academy at Andover and remained there for one year.[1] In 1829, at the age of twenty, he was graduated from Harvard and received a bachelor of arts degree.[1,13,16] Evidently Holmes was undecided about his career at this point. He proceeded to study law for one year and then embarked on a medical career. He studied at Boston and Paris, and traveled through several European countries over a short span of time. In 1836, at the age of twenty-seven, he received the degree of doctor of medicine at Harvard; following this he joined the Massachusetts Medical Society.[1,13,16] Is it not interesting to note that six years before Holmes set out as a practitioner of medicine he had written a poem that has firmly implanted itself among the classics in American Literature—"Old Ironsides." The strength and vigor of its verses foreshadowed the power and perseverence which were to be contributed some thirteen years later to the fight for a great cause and a noble aspiration.

In 1838, Holmes was appointed Professor of Anatomy and Physiology at Dartmouth College and he held this post for two years. When he was thirty-one years old he married Amelia Lee Jackson, daughter of Charles Jackson, who was a judge of the Massachusetts Supreme Court for eleven years. They had two sons and one daughter.[1]

In 1836, Holmes wrote a paper called "Indigenous Intermittent Fever in New England." Six years later he published material he had presented as two lectures, "Homeopathy and Kindred Delusions," in which he classed homeopathy with the Royal Touch, The Weapon Ointment, and Sympathetic Powder.[14]

Shortly after Holmes was graduated from medical school he published his first volume of poems.[9] Successful as he was as a poet there seems to be a difference of opinion on the question of how successful a physician he proved to be. Perhaps the difference of opinion results from divergent interpretations of the meaning of success. Supposedly Bostonians had difficulty in reconciling his witty verse and conversation with the seriousness of his medical career. Nevertheless of his status as a poet, there is no question. He was the last survivor

of the "New England Group" of poets. During his career, Boston was the "Athens of America" and Holmes was wonderfully fitted to be its unofficial laureate.[9]

Later on in life, in the year 1874, Holmes wrote a letter to the New Orleans Medical and Surgical Journal in which he stated:

"I do not believe much in rhyming doctors, and since I have fallen into that way myself, I have had no professional homicide laid to my charge, and that for the best of reasons—I do not profess to practice medicine. In my opinion a man who has life and death, and the bodily and mental welfare of his fellow creatures in his hands, should have no ambition outside of his proper calling. To do his duty by his patients will tax all his powers. There have been a good many physicians who have also been poets and litterateurs, but very few instances that I can at once recall where they have really excelled in both ways. . . . Goldsmith and Smollett were great writers but medical failures."[2,3]

Mary Marshall quotes John T. Morse:

" . . . a brilliant career in the way of practice not only did not begin early with him (Holmes), but it never developed at all."[2,21] And Holmes himself said, "The great practitioners are generally those who concentrate all their powers on their business."

It must be stressed at this point that when Holmes claimed in the letter quoted above that he did not profess to practice medicine, he was sixty-five years old. Nevertheless fully thirty years before this he was engaged in his profession and at the same time had an established reputation as a rhyming doctor. Perhaps there have been only few instances in which men have excelled both as physicians and poets. Today the fact is unquestionably accepted that Holmes does fit into that category. One must differentiate between the great practitioner and the great physician. Holmes may not have been the former but he definitely is the latter. Supporting this view, Dr. William Osler, in a much quoted obituary address before a meeting of the

Johns Hopkins Hospital Medical Society, proclaimed Holmes "the most successful combination the world has ever seen, of physician and man of letters."[15]

FIG. 1. Oliver Wendell Holmes.

In 1843, at the age of thirty-four, Holmes published his paper on "The Contagiousness of Puerperal Fever." This event was one of the most momentous in his medical career. It culminated a period of study and research, introduced a period of heated conflict and presaged an era of altered concepts in the treatment of cases of the dreaded puerperal fever. It is upon his work and teachings on this subject that the reputation of Holmes as a physician is based predominantly. Roy Finney remarks that this paper by Holmes is conceded to be the most important essay ever written by an American physician. "It is a product of that rare combination, a mind equally talented in both science and literature. Facts, arguments, deductions, arrayed as if by a master logician are expressed in the language of an expert in the art of rhetoric."[1]

Puerperal infection has probably occurred almost as long as children have been born.[8] The ancients regarded it as the result of the retention of the lochia and this explanation was accepted universally for centuries. References to puerperal fever are found in the writings of Hippocrates, Galen, and

Avicenna: In the early part of the seventeenth century, Plater claimed that it was a metritis essentially. In 1676, Willis wrote on "febris puerperarum" and the English term was probably used first by Strother in 1718. In the eighteenth century Puzos presented a milk metastasis theory. Many theories of the origin and nature of the infection were presented from the time of Plater until Semmelweiss proved the identity of the disease with wound infection, Pasteur had cultivated the streptococcus, and Lister had demonstrated the value of antiseptic technic.[8]

A prevalent theory in Europe for many years was that puerperal fever was due to miasmatic, telluric, or atmospheric influences. Even after Semmelweiss' book on the subject was published in 1861, this theory held its place. Hirsch studied the subject from a historical point of view and concluded that the disease was infectious, but the medical profession did not realize the importance of the disease as an infection until after the popularization of Lister's teachings and the recommendation of Stadfeld of Copenhagen that bichloride of mercury be used in obstetrical practice.[8]

Much credit belongs to Semmelweiss because his writings were based on personal investigations. Semmelweiss, however, was not the first to use a solution of chlorinated lime. Precedence goes to Thomas Alcock who used it in 1827.[8] In the United States the main indebtedness is to Holmes for introducing the idea that puerperal fever is infectious. Holmes' suggestions consisted of advising physicians to abstain from obstetrical practice for limited periods of time if they found that their patients were becoming infected. He suggested repeated bathing and changing of clothes between visits to obstetrical patients.[11]

The influence which Holmes' writings exerted were partially counteracted by the active opposition of Dr. Meigs and Dr. Hodge, outstanding figures in American medicine. The evidence collected by Holmes influenced them little and the observations on the contagiousness and epidemic character of puerperal fever made long before by Malouin at the Hotel Dieu in 1746, by Gordon at Aberdeen in 1795, and by Charles White of Manchester, England, in 1773, were of minimal significance as far as they were concerned.[8,10]

In his paper read before the Boston Society for Medical Improvement and published in the New England Quarterly Journal of Medicine, Holmes insisted that women in childbed should not be attended by doctors who had been doing postmortem examinations or attending to patients with puerperal fever. He said the disease could be transferred in this manner from one patient to another and that it could be transferred also to a patient from a case of erysipelas. A likely preventive measure would be washing hands in calcium chloride and changing clothes after attending a patient with puerperal fever.[11,15]

Twelve years after his first great medical publication the fight was still raging and there appeared another paper by Holmes which is listed among the medical classics, "Puerperal Fever as a Private Pestilence."[12] In this work Holmes repeated his views and referred to the work of Semmelweiss whose great achievement is evidenced by a mortality reduction among puerperal cases at the Allgemeines Krankenhaus in Vienna from 9.92 to 1.27 per cent. Yet at the same time Dewee's textbook, Diseases of Females stated, "In this country under no circumstance that puerperal fever has appeared hitherto, does it afford the slightest ground for the belief that it is contagious."[4,5]

In 1846, Morton demonstrated ether anesthesia on a patient on whom Dr. Warren of Boston operated successfully. The operation was for the excision of a vascular tumor. It was in a letter to Morton dated November 21, 1846, that Holmes suggested to Morton the terms "anesthesia" and "anesthetic" but he suggested consultation with an authority in the field before the terms were decided upon.[4,7,15] It is mentioned frequently that Holmes was the first to introduce this nomenclature. This

is denied by Sir William Osler, who in a talk before the Historical Section of the Royal Society of Medicine on "The First Printed Documents Relating to Modern Surgical Anaesthesia," said that the word "anaesthesia" is not a modern word but is encountered in Plato's "Timaeus" and was used by Dioscorides in the modern sense.

Holmes taught at the Tremont Street Medical School for several years and was connected with the Massachusetts General Hospital. In 1847, when he was thirty-eight years old, Holmes was appointed Parkman Professor of Anatomy and Physiology at Harvard. At the same time he was appointed Dean of the Medical School, retaining this post until 1853. It was years later, in 1871, that he relinquished the chair of physiology but he remained as Professor of Anatomy until 1882 at which time he resigned and was appointed Professor Emeritus.[1,13,11] Holmes was reputed to be an excellent lecturer, able, intensely interesting, pleasant, lively, and witty. Many people have been impressed by his metaphorical descriptions and Dr. Thomas Dwight said, "Medical readers will appreciate the aptness of likening the mesentery to the shirt ruffles of a preceding generation, which from a short line of attachment expanded into yards of complicated folds. He has compared the fibers connecting the two symmetrical halves of the brain to the band uniting the Siamese twins."[14] Holmes' attractiveness as a lecturer is apparent in his assignment to take the students in hand toward the end of the day when a less able speaker would have been unable to keep them awake.[13]

Of his attitude toward the nature of the work engaged in by the students no statement could be more enlightening than his own. He said, "We cannot wonder that the sensitive Rousseau could not endure the atmosphere of the room in which he had begun a course of anatomical study. But we know that the great painters, Michael Angelo, Leonardo, Raphael, must have witnessed many careful dissections, and what they endured for the sake of art, our

students can endure for science and humanity."[18]

With the arrival of the year 1857 came the forty-eighth birthday of Dr. Holmes. As one writer has indicated, Holmes is noted as being one of the greatest of American authors, but had he written an autobiography at the age of forty-eight when the majority of men have made their place in the world he would have written mainly as a man of science.[16] During this year his papers called The Autocrat of the Breakfast Table were published in The Atlantic Monthly which Holmes was helping James Russell Lowell to edit. Holmes' success was immediate and the remainder of his career was settled. He was now an author rather than a physician and he continued to publish essays, novels, and poetry.[13] The Autocrat was followed by the Professor of the Breakfast Table and the Poet at The Breakfast Table. There appeared later Over The Tea Cups and three novels, Elsie Venner, The Guardian Angel, and A Mortal Antipathy. It was the Autocrat which established Holmes permanently in American literature. Succeeding years saw additional literary endeavors and successes. Holmes published a biography of Motley, the historian and diplomat, and also a life of Emerson. After touring Europe in 1886 he wrote One Hundred Days in Europe and this was received well. Verses appeared rapidly, and each year for thirty-eight years from 1851 to 1889 Holmes wrote a poem for the reunion of his class at Harvard. Of his best known and still popular poems are The Last Leaf, The Chambered Nautilus, and The Wonderful One-Hoss Shay.[16] It was William Osler who suggested as a bed-side library for medical students ten works which he deemed worthy and sufficiently great to occupy the shelf. Tenth on that list is Oliver Wendell Holmes' Breakfast Table Series and it takes its place alongside the Old and New Testament, Shakespeare, Montaigne, Plutarch's Lives, Marcus Aurelius, Epictetus, Religio Medici, Don Quixote, and Emerson.[17]

In 1863, Holmes was University lecturer for one year and from 1876 to 1882 he was Overseer of Harvard College. Between 1880 and 1889 he received many honorary degrees: An LL.D. from Harvard and from Edinburgh, and Litt.D. from Cambridge, a D.C.L. from Oxford and an A.M. again from Harvard.[1,13]

When Holmes was eighty years old he was asked by William Osler whether he would rather be known to posterity as the man who in this country aroused the medical profession to the dangers of puerperal sepsis as an infectious disease or whether he would prefer to be remembered as the author of The Chambered Nautilus. Holmes' reply was, "There is some selfish pleasure to be had out of the poem, perhaps a nobler satisfaction from the life-saving labour . . . "[19] Probably recalling at this time his grand fray with the opposition of Meigs and Hodge, a statement he once made might very well be appropos: "To reach a port, we must sail, sometimes with the wind, sometimes against it, but we must sail and not drift, nor lie at anchor."[20]

In 1894, at the age of eighty-five, Dr. Holmes died painlessly while sitting in his chair. His life was full in years, in work, in achievement, in satisfaction, in goodness, and in fame. As applies to his spirit, no words could be better applied than his own: "To be seventy years young is sometimes far more cheerful and hopeful than to be forty years old."[18]

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SURGICAL HOSPITAL[*]

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FOR ten days to two weeks we are in the doldrums, bivouaced in a corktree grove, sitting around writing letters, washing clothes, sketching, studying anatomy and just rumor-mongering or speculating on our next move. During this time there has been increasing heavy gunfire in the distance and frequent commutation of plane squadrons overhead to and from the front. We are in the hills and at night the sky over the mountains flashes intermittently with brightness that is not lightning.

Then comes the alert we have all hoped for and yet dreaded. We are up at 5:30 A.M. for a messline breakfast of powdered eggs, hardtack and coffee. After that valpacks are strapped, air let out of mattresses, beds rolled and strapped tight with much heaving and sweating, tents struck and all loaded with convoy ready to move sharp on the dot of nine as ordered. The usual happens, however, and we sit in the loaded trucks till noon before starting. Perhaps you do not have a clear picture of what a surgical hospital, when on wheels, looks like. It takes over 100 two-and-a-half ton trucks, ambulances, weapons carriers, carryalls, command cars and jeeps to transport just this one outfit of some fifty officers, sixty nurses and three hundred enlisted men with equipment. Of course all those vehicles do not belong to us; some of them do but the rest have to be assembled from other outfits to move us. Maintaining the required interval of 200 yards between vehicles on the road, our convoy alone covers over ten miles.

Officers are called together, told the route and each assigned to the cab of a two-and-a-half to ensure keeping intervals and to avoid getting lost should we happen to mix up with other convoys on the road. I ride the truck carrying operating room equipment and have a pleasant colored boy from Georgia as my driver. The inside of his cab is studded in typical soldier fashion with pictures of beautiful girls in the nude, semi-nude or simply Hollywood sweaters. He is good fun, always humming or singing, and during stops he runs ahead to get cans of grapefruit juice and boxes of graham crackers from the ration truck which, as luck would have it, immediately precedes ours.

Lunch apparently has not been planned but I had been foresighted enough to pick up some cans of C-rations so we make out with cold stew, hash and "iced" coffee. The latter is produced by dissolving the ration powdered coffee and lump sugar in canteen water, mixed with lots of imagination. Rather lumpy but good nonetheless.

The trip is slow, dusty and hot. Cold as it is in the mountains of North Africa, the sun gives you a good going over from nine to four. We form only a small link in an endless chain that bumps along in white clouds of choking dust, stops and waits every little while and then bumps along again with much shifting of gears and swearing of driver. One pause lasts over an hour in shimmering heat waves while a whole convoy of heavy guns rolls slowly past round the curve and up the hill, the gun crews white with dust clinging precariously to their perches on trucks and carriages. At each stop flies swarm over us, vicious insects with bites that sting. Another pause and a division of engineers goes by, queer looking trailer trucks loaded with heavy bridge sections all ready to be slapped together when needed. As each vehicle passes we automatically hold our breaths and then fill our lungs with only half dusty air before the next comes along.

[*]This has been excerpted from a diary that was kept throughout the war by the author.

This is all country which has been bitterly fought over only a short time before. The road is rough and pocked with bomb holes which have hastily been filled in. All along on either side are huge and small craters and here and there a lorry or other vehicle which has been burned or smashed and. pushed off the road. Some are wrecks which had simply gone off a turn and over the bank in the blackout. It is evident that both Americans and British have been through here. Signs such as "Brooklyn Bridge" and "Pall Mall" have been stuck up on crude posts or scrawled on the walls of shattered buildings.

At one place we pass a dozen Mark VI tanks which have been shot up. Some of the tanks are completely overturned, some up-ended, some on their sides, some with three-inch shell holes through four-inch steel. Most of them are burned out. Incidentally, it was in one of them that I had been strafed by three Messerschmitts only a few days previously. I had gone up to look through them for parts I needed in building a suction pump for the operating room. I had just climbed into the least damaged tank and was having a wonderful time elevating and depressing the cannon and wheeling the turret around from the control tower when I heard the planes coming. They did not sound like ours and furthermore the ack-ack set up a terrific clatter so I dove for the bottom of the tank without looking up, figuring it was the safest place I could find. I just made it as my two enlisted men piled in on top of me. Then came the crump-crump of bombs and chatter of machine guns but fortunately nothing landed nearby. It was only afterwards I noticed the shelves around the inside of that tank were loaded with unused cannon shells.

About 5:30 P.M. we reach our destination, a beautiful site on a gently sloping hilltop in the open, midway of a long valley ringed on all sides by mountains. The latter are arid, rockridged and treeless. The wheat fields through which we bump and jog off the main road have obviously been used recently by tanks, artillery and infantry. Tracks run off aimlessly here and there and foxholes are numerous, each supplied with its telltale mound of empty ration tins, ammunition casings, waste litter and blackened stones. Down the hillside from us lie the tragic remains of an allied bomber where it had crashed and burned, engines, propellors and bits of wings scattered in all directions.

The first part of the convoy has already set up the O.R. and the mess tent when we arrive. The generator is hooked up and going. The place seems a bedlam of grinding trucks and shouting confused men. But the general layout of areas for operating rooms, wards, living quarters for officers, nurses and enlisted men has been planned and in remarkably short order a tent city springs up as though by itself with unseen power. The C.O. says we are due to start receiving cases at six. I think to myself, "Yes, yes, I know—that means we probably won't see a thing till tomorrow." So I slip off to my pile of baggage and get messkit and canteen cup. Chow is already being passed out but right on the dot of six and before I can eat a sergeant comes running to say that we have received a half dozen wounded, two major cases among them, and other ambulances are arriving. This is certainly one time the army knows what it is doing and does it.

So I check on shock treatment for the two worst cases, a belly and a shattered knee. Both have had plasma forward and need blood. While the transfusions are running I get my stew and. coffee. Then to work: a chest wound to be taken care of, a belly explored, fractures for reduction and splinting after x-ray, jagged wounds to be cleaned up and hemorrhage controlled and burns to be dressed under anesthesia. Now and then an extremity is damaged beyond hope of saving; somehow these seem the most pitiful cases. Patient after patient is brought in; six tables are filled all the time; an endless procession of new faces and injuries. "What's the matter with you, lad? Hurt badly?" "No, Sir,

I'm all right; just a bit of shrapnel from an 88." "You'll be O.K. in a jiffy—here, let's have a look at it; we'll put you to sleep first."

A pause for hot coffee and food at midnight; then we go back at it. We lose all track of time. The long tunnel of operating tent flooded with light, the smaller tent leading to it where we scrub and patients silently wait their turn, stretchers side by side on the canvas covered dirt floor, the trickle of cold water over our bare arms and the sting of bristles on raw skin, the sea of white drapes beneath caps and masks bent over tables, the hasty cutting away of clothing caked with dirt and clot, the stickiness of blood partially dried on fresh wounds, the sight of marble skin surrounding islands of scarlet or innocent looking puncture wounds revealed as the filth is removed—all make a confused picture that seems unreal; and yet here we are, here I am, a part of it, going on and on.

We are working under blackout; and such pitchblack darkness it is. It has commenced to rain and in a short time the ground is a slippery, slimy sea of clay which clings in great sticky knobs to shoes. Flashlights are banned; we are near the front now. Poor litter bearers struggle through the dark with their loads from receiving to x-ray to O.R. More loads, often heavier due to plaster casts, are carried from O.R. to wards. Stumbling and slipping, shoulders strained, muscles long since numb with fatigue, these men carry on. Tents are invisible in the black; one works by instinct in a seeming void, chilled and wet to the skin. "Hey, is this x-ray?" "No, dope, its Surgery Three." "Well, where the h . . . is x-ray then?" "Dunno, Joe, try second tent in the next row." And off again they go with heavy burden.

Long lines of ambulances loaded with torn humanity, their dim lights like pale watery eyes peering through the rain, inch forward bumper to bumper to discharge their pain-ridden cargoes into overflowing receiving tents and be off again. Quick,

deft examination of the endless stream of wounded follows; these are sent to shock ward, those to O.R. stat, others to x-ray; there is no time to ponder; the lightly wounded go directly to wards for hot coffee, soup and food. "Man, my first meal in three days and is it good!"

In another tent a group of surgeons work silently and swiftly to take blood for countless transfusions. A pool of volunteer donors from supply services is already on hand; as soon as some have given others take their places. Blood flows through the laboratory to the shock ward and O.R. in a steady life-giving stream.

I am off duty and due to get some rest the next evening when the C.O. greets me at supper: "Come and see a case with me; tell me what you think ought to be done." A lad of twenty, toxic and delirious, strafed by a plane two days before, has a compound fracture of both ankles. His feet are swollen and discolored, the wounds green and stinking, with telltale bubbles beneath the skin—gas gangrene. He needs attention and in a hurry. Transfusions are started, anti-gas gangrene serum and sulfonamides given intravenously in massive dosage, along with fluids and glucose. Blankets and hot water bags are used for shock. Meanwhile a separate pyramidal tent is set up for isolation; a stretcher serves for a table and within an hour both legs are removed below the knee. A special nurse and ward boys are assigned but the patient is too sick for me to leave; he is still toxic, delirious and violent as reaction comes from the anesthesia.

The needle clogs; the veins are thrombosed and the low pressure, due to shock, keeps them collapsed. I try to get into another vein but cannot; I cut down and expose another but that is clotted solid. The third try succeeds but it is all we can do now to hold his arm steady and keep the needle in the vein. It is early morning and the patient is restless and screaming. Morphine does not touch him, nor does sodium amytal. He does not seem so good; he is paler and colder. A glance beneath the

blankets reveals a secondary hemorrhage; the dressing on the left stump is soaked with fresh blood. An emergency tourniquet is quickly tightened; fresh instruments and dressings are brought from the O.R.; the stump is bared, the bleeder found and sutured and a new dressing applied.

Over and over I keep thinking, "Why bother—the kid can't make it anyway—he's cooked—no blood pressure, pulse like a trip hammer and barely felt at that—respirations way up—skin like parchment—nose pinched and nostrils sucked in with effort to breathe—lips blue—hands cold as ice. Besides, if he does he'll be a cripple for life." I cannot shake these thoughts but I keep on, automatically, as one possessed. Oxygen is tried but he does not get much; he is too violent and will not tolerate the mask. Another transfusion is given while the needle remains in the vein.

It is bitter cold in that tent and there is no means of getting heat. An overcoat helps but it gets in the way. Heavy thunder storms and pouring rain continue unabated outside; it makes an incessant rattle on the canvas. There is a call for me—I am wanted in the O.R. This time they will have to do without me; someone else will have to take it for I am not leaving. A major comes over; there is a bad case, compound fracture of both thighs, to be done. "OK, get so-and-so; I'd like to help you but I can't drop this yet."

Three days later our lad is still with us and for the first time he asks for water.

What a wonderful sound those few words made; I'll never forget. He has gone further back now and I do not know what has happened to him but I'm sure he made the grade. What a tragedy the loss of his feet but he will walk again and, as we told him, it is not as bad as an arm.

Then comes a glorious spring day, with bright sun, cloudless skies, wheat fields ruffled by a grateful breeze and a yellow green countryside deceptively peaceful. Suddenly there is a loud explosion and heavy smoke rises in an inverted cone from a field nearby. Arabs, horses, cattle and sheep scatter in all directions, their paths clearly marked by fresh furrows in the waist-high grain. A land mine has been touched off. Soon details are known: Three Arabs have been killed outright and there are five others for us to patch up. There is nothing unusual about this. The fields were sown with mines by the Germans. Now that the Arabs are returning to their homes accidents are bound to happen. Unused hand grenades, left behind in the rush of advance, are devil's bait for Arab kids—children with knees blown through, hands mutilated, faces crushed—a bloody toll of the innocent.

One week passes and the heavy rumbling that has formed a part of our life day and night since arrival has dwindled in the distance. Admissions taper off. In two days no more casualties appear. Bizerte is taken, Tunis has fallen, the campaign in North Africa is at an end and we are ready to move.

EVOLUTION OF SURGERY

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SURGERY has rightly been called the Queen of the medical arts. Its history is also the history of man himself. Even the most primitive races had a surgical lore of sorts. The first surgery of mankind was probably that of extracting arrows received in combat and healing the wounds incidental to hunting. As the infliction of the elements and less friendly living creatures grew more relentless a more complex surgery was evolved. The skull in cases of severe headache was opened; an impressive collection of Peruvian skulls, plainly bearing evidences of trephening, speak eloquent testimony to primitive surgical skill. Surgical instruments, fashioned of stone, have been unearthed, and modern surgeons have demonstrated by actual experiment, the feasibility of working with such instruments. Moreover, paleolithic art has preserved the earliest evidences of surgical craft in the caves of Europe, where drawings representing hands that have been mutilated either accidentally or surgically still exist. Some of these drawings represent hands from which one or more of the fingers have been removed, suggesting injuries received in the handling of the rude implements then in use or amputations as the result of such injuries.

The remarkable researches of Dr. Marc Ruffer in paleopathology which he carried on upon ancient Egyptian mummies reveal an astounding knowledge of surgery among the ancient Egyptians. Many of the surgical procedures heralded in later centuries as new were long ago known to the Egyptians. Eye surgery, especially, attained a high plane of development. The abdomen was opened in diseased conditions and the abnormality skillfully corrected. They, moreover, had great skill in opening the skull and this method of therapy was used in curing migraine and epilepsy. They also performed circumcision and removed superficial tumors.

Greece, in somewhat later times, became fertile soil in which the art of surgery grew lustily and flourished. The fifty years preceding the birth of Hippocrates, the Father of Medicine, was a favorable one. There had come a sudden rush of expansion among the Greeks to the west. The Persians in the east were extending their boundaries and rolling forward to the Mediterranean those vast armies which the Greeks crushed at Plataea, Salamis and Mycale. During this time military surgery expanded marvelously and enriched the experiences of surgeons who used their newly acquired knowledge and skill for the benefit of the citizens as well as for the soldiers.

Close upon the heels of this important surgical era came that of Hippocrates whose achievements in surgery no less than in medicine helped to establish the early science on a firmer footing. This Goan treated with success diseases of the bones and joints, ulcers, fistulas and hemorrhoids. He trephined the skull, reduced hernias and repaired defects that Nature had left in too hurriedly completing a job. He removed stones from the bladder with signal success, and he was among the first to describe artificial collapse of the lungs and to open and drain the chest in cases of inflammation and pus formation in the lung coverings.

After Hippocrates there was no notable name in surgery for five hundred years. Galen, of Alexandria, made his appearance after this lapse of time, and his contributions to the healing art gave it new prestige. Perhaps his greatest contribution to surgery was the ligaturing of arteries. Moreover, he devised a new treatment for weakened artery walls. He was especially interested in the nervous system upon which he carried out many experiments through

which he originated many new surgical procedures for the cure and relief of injuries to the brain and the spinal cord.

The Middle Ages furnished a wonderful array of names: Bruno da Longoburgo, Hugh, of Lucca, William, of Salicet and Lanfranco. Those of western Europe were Henri de Mondeville, Guy de Chauliac, John of Ardern, and John Yiperman. Bruno helped to clarify the meaning of the term surgery; he wrote a code of ethics for surgeons to observe. In 1252, he published his great work "Chirurgia Magna" in which he advocated several surgical innovations. He insisted that the essentials of surgery were to bring separated parts together, to separate those that have become abnormally united, and to extirpate what is superfluous. Bruno advocated the dry treatment of wounds and devised several interesting procedures in abdominal surgery. If there was difficulty in bringing about the reposition of the intestines, he advised that they were first to be pressed back with a sponge soaked in warm wine. If the omentum, the apron-like structure in the abdomen, happened to squeeze its way out of the wound, all that was black and green, must be removed. In cases in which the intestines were wounded they were to be sewed with a small needle and silk thread, and care was to be exercised in bringing about a complete closure of the wound.

Following Bruno the next surgeon of importance was Hugh of Lucca. His most important contribution to surgery was anesthesia. Mandragora served as the base for an anesthetic in those days, though a combination with opium was the favorite. Da Lucca's method was by inhalation, and this means of administration was used for fully a century; it consisted of saturating a natural sponge with a solution of madragora, opium, hyoscymamus, lettuce, camphor and nenuphar. This anodyne was dried and when the occasion for using it arrived it was moistened with hot water and held to the patient's nostrils until he fell asleep. Lucca was among the first to observe strict cleanliness in the treatment of wounds. He avoided the use of the probe and employed compresses soaked in wine.

By far the greatest surgeon of the thirteenth century was William of Saliceto. He, like Lucca, had considerable experience in military surgery, and the outcome of his wide experience and researches was a systematic work on surgery. He set down in detail the treatment of various sorts of wounds, the suturing of nerves and intestines and the treatment of fractures and dislocations. He distinguished between hemorrhages from the arteries and veins. His method of treating water on the brain is of particular interest. He rejected opening the skull and recommended instead puncturing the scalp and membrane by a cautery, a very small opening being made and the fluid being allowed to escape only drop by drop. Saliceto's discovery tended to popularize the use of the cautery in surgery.

As Saliceto was the most distinguished surgeon of the Thirteenth Century Lanfranco was the foremost surgeon of the Fourteenth. He was exiled from Italy and came to France to live where he produced his "Chirurgia Magna." He argued that it was silly to fix a line between the work of the surgeon and that of the physician and between practice and theory. He gave a good account of the symptoms of fracture of the skull, and was the first to describe concussion of the brain. He recommended ligature as a means of stopping hemorrhage, and maintained that exposure to the air favored the formation of pus in wounds. He advised cutting the nerves in cases of traumatic tetanus. A thing for which he was noted was his method of stitching nerves completely divided in cross-section. This he said was the surest method of reintegrating the nerve. Not only was the nerve itself rehabilitated by this method, but after the operation the restoration of usefulness to the member involved was more complete.

The foremost pupil of Lanfranco was Henri de Mondeville who, above all,

pointed out the necessity of a friendly relationship between physicians and surgeons. Unlike his master he differentiated between theory and practice, and he insisted on a practical acquisition of surgical knowledge rather than theoretical. He advocated moderate boldness and did not countenance radical surgical treatment. He was impatient with the surgeon who was ever ready to employ surgical means when medicines would do as well. He evidently was not very satisfied with the state of the surgical art of his day, for he remarked: "Many more surgeons know how to cause suppuration than to heal a wound."

The most brilliant contemporary of Mondeville was Guy de Chauliac, who, in many respects, was as great a surgeon as Lanfranco. He, like Mondeville, insisted on experience rather than on authority. In cases of fracture of the leg, in addition to splints reaching to the foot, he employed a box or truss of straw to support the limb and attached to the foot a lead weight by means of a cord passing over a little pulley. He advocated that cancer be treated at an early stage and preferably with the knife. He made use of the speculum in certain obstetrical cases, and he gave an account of a ceserean operation. His special interest lay in the radical cure of hernia, and he devised six different operations for that purpose. He, moreover, developed a method of taxis by which to reduce hernias. He adopted stiffened bandages of various sorts, especially employing white of egg for this, and sometimes moulding bandages to the limbs in cases of fractures.

John, of Ardern, and John Yperman were among the later medieval surgeons of note. Ardern described rabies and drew an accurate picture of that disease. He also knew the clinical manifestations of traumatic epilepsy and suggested treatment. Yperman was well acquainted with and treated cases of dropsy, rheumatism, apoplexy, epilepsy, lung abscess, hemorrhage, liver abscess, blood-spitting, hardening of the spleen, and a host of other surgical diseases.

The greatest surgeon at the dawn of the Renaissance was Ambrose Paré. "Mere knowledge without experience," he said, "does not give the surgeon much self-confidence." All his own knowledge was acquired through experience, first as a dresser at the Hotel Dieu and then as a military surgeon. He treated with success wounds inflicted by sword, lance, halberd, stone arquebus, pistol, culverin and other types of firearms. He described various forms of fractures, including fractures of the leg, the arm and the skull. He was the inventor of arterial forceps, many different kinds of surgical instruments as well as artificial limbs and artificial eyes. Paré suggested that syphilis was the cause of weaking of the walls of the great arteries of the body. He was the first to use wire sutures to treat harelip. He removed concretions from the joints, improved the method of trephening, and made remarkable advances in the surgery of the eye. However, he is most known for his improvement in the treatment of wounds and because he introduced the ligature in amputations. In former times custom prescribed that wounds should be treated with boiling oil. Paré hit upon the idea, quite accidentally, of utilizing an extemporized simple ointment instead of boiling oil. His men recovered much more rapidly under this system. His introduction of ligaturing arteries instead of using the cautery abolished the ancient dread of bleeding to death and saved many lives.

Doctor Saleeby has said that the history of surgery may well be divided into two periods: Pre-Listerian and Listerian. During the interval that elapsed between Ambrose Paré and Lister surgery was enriched by the contributions of a remarkable group of men: Borelli, the physiologist, Malphighi, the anatomist, Paracelsus, the chemist, Van Helmont, who elaborated the teachings of Paracelsus, and Harvey, who discovered the circulation of the blood The pre-Listerian period was characterized by the presence of pyemia, septicemia,

erysipelas, and hospital gangrene which were certain to follow surgical intervention. With the introduction of ether and chloroform, operations increased in number and range. The mortality caused by the above mentioned infections was appalling. Lister particularly concerned himself with the problem of controlling these diseases, and with his appointment as professor of surgery at the University of Glasgow he buckled down for a practical solution of this problem. His special interest lay in the study of suppuration in relation to decomposition. From previous experience with carbolic acid as a deodorant and destructive agent in entozoa, it occurred to him that carbolic acid might prevent suppuration in cases of compound fracture. The first attempt to use carbolic acid in the treatment of compound fracture was not successful; in August of the very same year, however, this new method was employed with complete success in a case of compound fracture of the arm. Other successes followed this one and within a period of two years Lister's wards in the Glasgow Royal Infirmary became the healthiest in the world. At first he had prejudice and ignorance to fight, but in time the greatest surgeons in Europe were won over to antiseptic surgery. First came Thiersch and Richard Volkmann, of Germany, then Billroth, of Vienna, and Lucas-Championniere, of France. With these leading surgeons accepting the new doctrine the practice became widespread, and a wonderful new era in surgery was ushered in. Operations which no one would have dared to have undertaken because of the almost certain fatal outcome were now attempted with impunity.

Among the most notable operations in the dawn of Listerian surgery is that of Sir Victor Horsely for the excision of the Gasserian ganglion in neuralgia. This operation has been of great value in restoring elderly people to a life of usefulness, whose existence previously had been one of pain and misery. This operation could not have been undertaken in pre-Listerian days

without certain death; yet today the skull may be opened, a large area of the brain exposed and turned aside and the Gasserian ganglion removed. Today 10 per cent of brain tumors are amenable to surgical treatment with good prospects of full recovery in a majority of cases.

The present age is so important in surgical history that the student of medical history in the future will have more to say about the present era than students of today have to say about all preceding periods. The World War served as a powerful impetus. Surgery was put to its severest tests and had to advance at a lively pace. Blood transfusion as a therapeutic measure for the combatting of shock and hemorrhage was widely resorted to. Methods of anesthesia were improved and facilitated. So was radiography and other means of determining before operation the nature of the injury and the exact location of bullets, shrapnel, and other foreign bodies. Small fluorescent screens that could be closely applied to the skin of the patient were used. Fractures and other injuries that could not be detected on the screen were often revealed by an examination of the plates. In not a few cases stereoscopic radiographs proved of great value.

Some of the most notable results were achieved in plastic and kineoplastic surgery. The restoration of faces of soldiers mangled by instruments of the most fiendish design of modern warfare evoked the most popular admiration. Quite a few years back it was something of a feat to restore a nose lost by disease or accident. Now it is an everyday occurrence. Various parts of the body are now restored with a wonderful degree of nicety. Plastic surgery has made progress in leaps and bounds.

Commenting on the progress that Listers discovery has made possible in surgery, the late Dr. William Williams Keen made note of the following: "Amputations have decreased. Instances which in pre-Listerian days would invariably demand amputation are now quite possible of recovery without amputation. External tumors are now

removed without fear of erysipelas from all parts of the body. Even in cases where the tumor is internal there is no hesitancy about removing it. Opening the skull for curative and exploratory measures is now more frequent. Abdominal operations which would have been formidable several decades ago are now commonplace. Today the brain surgeon attacks tumors of even so inaccessible a place like the pituitary gland at the base of the brain, punctures the lateral and fourth ventricles of the brain, successfully extracts foreign bodies and in some cases relieves epilepsy and mental disorders. In the neck, goitres of any size are removed; in the chest the heart itself is sutured for gunshot and stab wounds, treated surgically for severe types of heart disease; the esophagus is treated for cancer; large portions of the chest wall are removed for treating cancer of the lungs."

The abdomen may be opened and various operations performed, even the total removal of the stomach, without the least danger. The intestines may be opened, anastomosed and short-circuited. Tumors of the liver, gallstones and gallbladder may be removed with ease. In the pelvis the bladder may be opened, rebuilt when it is defective and even wholly removed when it is hopelessly diseased.

Very impressive advances are being made in transplantation surgery. Skin, bones, joints and even half joints are transplanted with success. The trend in this direction is to transplant organs from healthy individuals to those whose organs have been destroyed by disease. Remarkable instances are the transplantation of testicles and thyroids for rejuvenation. Nerves are sutured and anastomosed. The same is true for blood vessels. The blood stream is criss-crossed to prevent gangrene.

Surgery today is veritably a super-surgery. There is no problem too difficult for the modern surgeon to tackle. The accomplishments of recent surgery thread a story full of wonder.

DOCTOR WATSON, I PRESUME?

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WATSON designates himself in the explanatory sub-title of "A Study in Scarlet" as John H. Watson, M.D. This is his signature to the Preface of "His Last Bow," and it is part of the inscription painted on the "travel-worn and battered dispatch-box." · His first published work opens with the words: "In the year 1878 I took my degree of Doctor of Medicine of the University of London." By virtue of such evidence no one appears to doubt that Watson was the holder of a doctor's degree in medicine. But the matter is open to the most serious question.

In "The Field Bazaar" Sherlock Holmes deduced that a letter Watson had received from Edinburgh University was an unofficial communication: "This I gathered from the use of the word 'Doctor' upon the address, to which, as a Bachelor of Medicine, you have no legal claim." That would seem to settle the matter of the doctorate. No doubt there will be objection raised to this on the ground that "The Field Bazaar" is not ʼcanonical. But in text that undeniably is Watsonian, "The Adventure of the Dying Detective," Holmes bluntly tells Watson that he has only "mediocre qualifications" as a medical man. Could the M.D. from London be described as "mediocre"? Certainly not; this degree is an extremely difficult one to obtain.[1]

In further proof, if it be needed, of the spuriousness of Watson's alleged degree, it may be mentioned that the University of London has no record of a John H. Watson taking the M.D. in 1878. And if it is unlikely that Professor Moriarity caused the record of Holmes at Cambridge to be obliterated,[2] it is still more improbable that he would trouble himself about Watson's academic history.

Even if Watson's medical degree was not what it might have been, he earned, many times over, a doctorate of letters. No one begrudges him the use of a title, but he should not have tried to deceive us. "What is the meaning of it, Watson?"

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Editorial

CARDIAC DISEASE AND CESAREAN SECTION

CARDIAC disease is an important cause of maternal mortality. In several well conducted obstetrical clinics, it ranks fourth in frequency as a cause of maternal death, following hemorrhage, infection and toxemia. Janssen believes that each year in the United States, 1,000 puerperal deaths are due to heart disease. Exact figures are not available, except as published in maternal mortality surveys.

The controllable factors of mortality will be found more readily in the problem of antepartum care than in the conduct of delivery. General interest is comparatively recent, yet so acute that active cooperation of the cardiologist, or experienced internist is now widely accepted as essential. In the event of serious break in compensation during pregnancy, insistence upon hospitalization to the end of term, no matter how far off that may be, is necessary. In some circumstances, that may not be practical, yet the obstetrician who is willing to share the risk of home care weights himself with grave responsibility.

Since a great many women with cardiac disease have been successfully delivered by the vaginal route, many misconceptions are rife. It is commonly said that short labors and small babies may be anticipated, and that a considerable loss of blood is common and even good for them; and,

since there is reason to believe that they stand surgery well, it is thought that cesarean section presents no special problem. There is no evidence to support any of these notions.

In the more serious cases, as the circulatory burden of pregnancy increased, it has seemed reasonable to induce premature labor in order to lessen the risk of delivery at term. The high mortality which followed this method of treatment has resulted in greatly increased incidence of cesarean section and higher maternal mortality.

Now we know that spontaneous improvement toward term can be anticipated with confidence, so induction of premature labor is clearly contraindicated; and there is excellent evidence that the mortality associated with cesarean section is much higher than for pelvic delivery. The incidence of cardiac failure itself, as well as embolism, hemorrhage and sepsis is higher too after abdominal delivery. Many clinics, however, remain unconvinced and continue to perform cesarean section for serious rheumatic heart disease. It is true that the case for and against abdominal delivery can not yet be supported by citing parallel cases in large numbers, yet it is clear that enthusiasm for cesarean section is waning.

The patient with heart disease is a poor

risk for cesarean section, whatever the reasons for this may be.

To say that this method of delivery still has a place in the treatment of those women who fail to improve under critical supervision is fallacious. If a cardiac patient should die undelivered in the latter months of pregnancy, it does not mean that cesarean section would have averted the fatal outcome. Unfortunately, she would have been a poor risk for pelvic delivery as well. There will always be fatalities. To perform cesarean section in order to sterilize a patient, who might better have been delivered from below is not good sense.

The essence of success in the management of pregnancy complicated by rheumatic heart disease is good antepartum care. No obstetrician should be willing to assume responsibility for pregnancy complicated by serious rheumatic heart disease unless an experienced internist shares it with him. Functional evaluation, spontaneous labor, critical supervision of the first stage of labor and shortening of the second stage are important.

Cesarean section is contraindicated for cardiac disease. However, the obstetrician need not be told that obstetrical problems like pelvic dystocia, over-large fetus or placenta previa must be solved satisfactorily and cesarean section may be necessary.

In Brooklyn the Committee on Maternal Welfare of the Medical Society of the County of Kings invites all physicians to participate in its monthly obstetrical conferences at which the controllable factors of maternal deaths are discussed. No formal assignment of preventability or responsibility is ever assigned to any physician or hospital. The purpose of these conferences is purely educational, in a deliberate effort to influence local trends of practice. Interest has been well maintained for a period of ten years.

A recent meeting of this Committee was devoted to a review of maternal deaths due to rheumatic heart disease. Three able cardiologists, representing Brooklyn hospitals in which obstetrical cardiac clinics are conducted according to the standards of the New York Heart Association, participated actively in the discussion. They were of the opinion that cesarean section is contraindicated for rheumatic heart disease. It is difficult to believe that this meeting will not have a profound effect upon obstetrical practice in Brooklyn. Similar meetings in other large urban centers, in which the statistical trend of puerperal mortality should approximate national experience, should influence obstetrical practice and further reduce the maternal death rate. Performance of cesarean section for rheumatic heart disease should be discouraged.

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BONE GRAFTS IN NON-UNION OF WAR FRACTURES

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NON-UNION of fractures with gross defects in the long bones is a common occurrence among the shattering injuries of war. To correct these structural problems bone grafts are the most valuable and useful aid in the reconstructive surgery.

This article describes the observations of our practical experience for the past two years with the use of bone grafts in fractures of the long bones at the Valley Forge General Hospital. A wide variety of problems caused by weak union, mal-union, non-union or gross defects have been met by inserting bone grafts. No fixed concepts have been applicable to all cases. Many sources have been used for the donor bone and varied technic have been utilized to meet the individual problems.

Illustrative cases are shown to demonstrate the three general purposes of these grafts: (1) to promote union across a fracture site, (2) to bridge a gap in the bone due to loss of substance, and (3) to reinforce weak bone.

In this type of reconstructive surgery time and care must be taken preoperatively to analyze and evaluate all of the following factors: (1) timing, (2) skin surface, (3) bed, (4) source, (5) type, and (6) fixation.

Timing. The proper time to operate is a flexible quantity. First, the general condition of our patients usually permitted early consideration of operation because the recuperative powers of youth are amazingly rapid. Only occasionally did an operation have to be delayed in order to build up their general condition.

Secondly, the time when it became certain that spontaneous union would not take place was indefinite. Reasonable bone contact and control of infection often resulted in union, even if delayed. For this reason it was frequently not easy to make a decision. For example, two patients with delayed union of the tibia were operated upon with intent to perform bone grafts. In both instances unexpected abscesses were found at the sites of the non-union. The pus appeared innocuous, but yielded positive cultures of Staphlococcus hemolyticus. As a safety procedure the ends of the bone fragments were cleaned up and saucerized. They were then placed in fair apposition, the wounds were left open with light packing, and the limbs were incased in plaster. Union followed in both instances. Whenever in doubt the delay of conservative treatment sometimes resulted in union.

Thirdly, the hazard of infection in these compound wounds was theoretically never past. A practical general rule was to allow the lapse of eight to sixteen weeks after all visible infection had ceased and the sinuses had closed. Even this guide was permissible only with the routine use of penicillin pre- and postoperatively. It was far better to wait and be safe. If the graft failed because of infection, it would be six to twelve months before another procedure could be undertaken. Furthermore it usually happened that the best bone donor site had been used up fruitlessly. Fortunately very few failed.

Skin. A factor of tremendous importance upon which so much of the recon-

structive surgery hinged was the skin surface. It was repeatedly shown that the covering above the graft was of vital overlooked. But it was found that it is not only necessary to have a good surface covering above the graft, but also healthy

FIG 1. Case I A, shrapnel wound occurred in Sicily. Non-union of the clavicle followed a compound fracture with loss of substance. B, a graft from the tibia was applied as an onlay and was fixed with four screws C, screws were later removed because they were tender beneath the skin.

significance to its life. Any real amount of scar tissue above a graft was prohibitive. Since the plastic surgery service had always offered close coöperation with this work, it became an inflexible rule not to perform a bone graft unless skin and subcutaneous fat covered the area without tension. In blood-bearing tissue around all of its other sides. In the severely destructive wounds, usually caused by shrapnel, healing took place with the formation of a large amount of dense scar tissue. Often there would be a hard, almost bloodless, mass through and through the arm or leg, the hand or
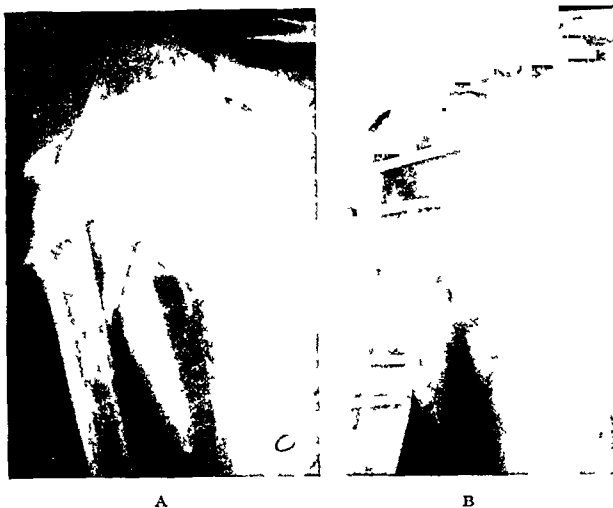
FIG. 2 Case II. A, injured at El Guettar, North Africa, when a jeep hit a land mine. The compound fracture of the humerus resulted in non-union because of interposition of tissue B, a cortical graft from the tibia was inlayed into the upper fragment and onlayed distally along the shaft.

the consideration of any bone graft procedure the source of its nourishment from the surrounding tissue was a prime factor to examine. Scar tissue would not sustain a graft.

Bed. The bed of the graft was a point of real interest, and at first was somewhat foot. Sometimes this covered a large area across the limb, and at other times the scar would run up and down for several inches. To lay a bone graft in this substance was to ask for failure. Therefore, all of the scar tissue was meticulously dissected from the area which surrounded the

FIG. 3. Case III. A to E, wounded in action by shrapnel in Tunisia. A two and a half inch gap in the continuity of the ulna was left after the infection had cleared. In this instance the scar below the elbow was completely excised by the plastic service and the defect was covered by the transfer of a local flap of skin. The area from which it was moved is shown in the picture to be covered with a split graft. Nothing is visible of the original scar area. A fibula graft was dowled into the medullary cavity of the upper end while the lower end was "stepped" against the ulna shaft and held with two screws with nuts. The olecranon worked loose in this case and the upper end did not unite until a secondary procedure was done.

graft. Sometimes this would require pro-longed and extensive excision. By prefer-ence the graft was immersed in normal

FIG. 4. Case IV. A, wounded by a shell fragment near Mateur, North Africa. Non-union of the ulna was caused by loss of substance. B, united by an onlay cortical graft from the tibia.

appearing muscle, or at least with a good muscle bed below and subcutaneous fat and skin above.

Sources. Bone for grafting was bor-rowed from many sources. The body stock-pile of useful material is plentiful. By forehanded planning the proper areas were prepared and readied. Nevertheless the needs of the moment had to be met. For example, in Case VI it was intended to use an iliac graft because of its osteogenic property, but the uncovered ends of the ulna were so soft and decalcified that they would hold neither screws nor wire for fixation. In order to meet this immediate problem the tibia was prepared and a long, 16 mm. graft was removed and divided in two as a dual graft. Both ends of the ulna were held in vise-like grip of the dual graft.

The oldest and most reliable source for bone remained the tibial shaft. If extra long or strong shafts were required, either

the tibial crest or the fibula was used. By choice the tibial crest was avoided because of the reported frequent fractures in such

FIG. 5. Case V. A, fragments from a bomb at Anzio caused the loss of substance in the middle ulna. B, the gap was filled in with a fibula step graft. The lower step broke while the screws were being inserted and a plate was then applied to hold it.

donor sites even six months or more after removal of the graft. Six to eight inch sections of the whole fibula have been taken several times without any residual symptoms. In one instance the fibula graft failed and the best explanation seemed to be lack of nourishment. Since then the practice has been to slice off one of the edges of the graft with the motor saw so that its marrow cavity was exposed to ingrowing blood vessels.

For its splendid osteogenic properties the iliac crest was an excellent source of borrowed bone and it was used frequently. Commonly the outer half of the crest was removed but different shapes were designed from either the crest or ala, according to the need. The crest was also the best area from which to obtain bone chips if no immediate source, such as the cancellous bone of the upper tibia, was available.

A   B

C   D

FIG. 6. Case VI. A, a severely destructive wound of the forearm was
caused by shrapnel near Cassino, Italy. The soft tissue was first
healed. B, the scar was replaced with a large abdominal flap by the
plastic service. C, the non-union of the radius and ulna is shown. D,
the radius was opposed by a screw and nut through the oblique con-
tacting surfaces. The ulna ends were found to be so soft that mortices
could not be cut and screws would not hold. Therefore, a dual tibial
graft was used. The ends of the ulna were crushed tightly between the
two grafts.

A section of rib was easily removed and used as a whole, or split into two grafts which were quite serviceable, for instance,

FIG. 7. Case VII. A, a defective radius was caused by a shell fragment near Venofro, Italy, and refractured without displacement during convalescence. B, the gap was then filled in with a graft from the iliac crest.

in a wrist fusion. Small grafts for metacarpals were taken handily from the proximal ulna. Recently in two cases the distal half of the fifth metatarsal was borrowed to replace the like part in metacarpals. In this manner the cartilaginous joint surfaces were utilized; both grafts were successful and the metacarpophalangeal joints were saved.

Often the bone adjacent to the fracture site was the best available source and a sliding inlay graft was done. However, the more desirable graft for inlay to the lower tibia came from the healthy bone of the opposite leg. Osteoperiosteal grafts were usually taken from the tibia, also.

Types. The type of graft used depended upon a number of special considerations. If it were to be fixed near the end of a long bone, the end of the graft was best driven into the cancellous metaphysis as an inlay or intramedually type. The blood

supply of cancellous bone is so luxurious that it adds great odds for a take.

If the recipient ends were decalcified
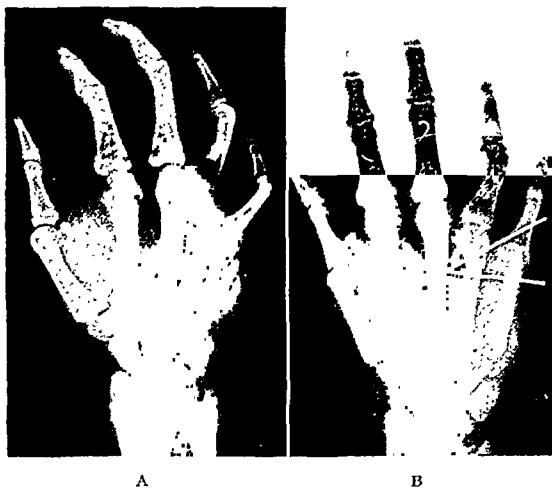
FIG. 8. Case A and B, the gap in the fifth metacarpal was caused by a rifle bullet. It was made up by a small tibial graft, notched into the proximal end of the metacarpal and driven distally into the medullary canal of the first phalanx.

and soft, they did not lend themselves to bone carpentry. Several times at operation the fracture ends, apparently sound by x-ray, were found to be actually sclerotic or else flattened in the wrong direction so that the anticipated type of graft contact had to be changed.

Onlay grafts were the most desirable type for shafts of long bones, provided a good bed of bleeding recipient bone could be obtained. On both the femur and tibia they were applied to the outer aspect. The difficult area of lower tibia was best joined by a combination inlay from the opposite tibia plus an onlay graft along the lateral border, using the bone removed from the recipient slot. In one difficult case (Case XI) a sliding graft and also the onlay were taken from the same tibia because the other tibia had been badly fractured.

Metacarpal and metatarsal problems were met in special ways, sometimes by borrowing the distal end of the fifth metatarsal. Usually cortical bone grafts from any convenient source were quite satisfactory.

Osteoperiosteal grafts were desirable when rigidity was not required but bone growth was to be especially promoted.

across the fracture line. Similar sluggish fracture sites have been wrapped all around by such osteoperiosteal grafts, or

FIG. 9. Case X. A, bilateral femoral fractures resulted when a truck overturned during a blackout in Italy. The right femur had united but the left had not. B, a tibial graft was inlayed into the greater trochanter and onlayed against the shaft.

FIG. 10. Case XI. A, a glider crash in Texas caused this non-union of the tibia because of the considerable loss of the anterior cortex. B, a long sliding graft from the same leg was used because the other tibia was also fractured. The fragment from the upper slot was placed as an onlay against the lateral surface of the tibia.

Recently a difficult old non-union of the femur had three inches of over-riding which could not be corrected. The ends were "stepped" into excellent apposition and held with a six-screw plate but the non-union was about two years old and the ends were of poor quality bone. To insure union a six-inch osteoperiosteal graft was layed down along the top of the femur

else chips of cancellous bone have been packed about them.

Dual grafts were excellent to make up the defects in long bones. Sometimes sufficient length for the double graft could not be cut from the one tibia. In these instances eight or nine inches of the opposite fibula were utilized. Another similar way of obtaining a dual graft was to do an

osteotomy of the fibula of the same leg, above or below, or both, and fix one or both ends against the damaged tibia. In

as any of the other factors. In many instances it was wiser to sacrifice a small amount of length in order to get healthy

A   B
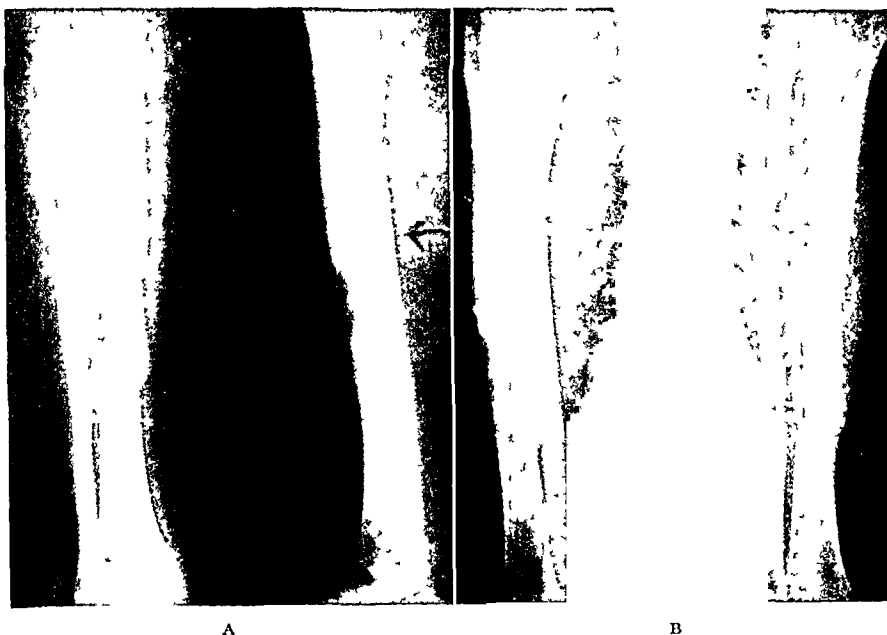
FIG. 11. Case XII. A, the non-union of the upper part of a double tibial fracture, resulting from an automobile accident, was caused probably by lack of nutrition. B, an onlay graft from the opposite tibia was fixed along the lateral surface. Anteriorly an oblique transfixing screw was inserted for better fixation.

A   B

FIG. 12. Case XIV. A, a gasoline drum exploded in Tunisia and caused the large defect in the upper tibia. B, a graft from the iliac crest was used to secure rapid union because the fragments were quite stable.

addition to this an inlay or an onlay was added from the other tibia. Such a wide variety of tibial defects were found that many different combinations of supporting grafts had to be devised.

Fixation. The method of fixation of the ends of the graft were just as variable

bone ends in good contact. This was especially true of the bones of the arm where a moderate shortening was but a slight handicap.

The method of cutting steps for splicing provided several advantages. Marrow was brought into contact with marrow and

cortex with cortex; and it lent itself to close-fitting fixation by screws or even by wire. Yet one had to be ready for other

grafts were held by two screws at each end; but they did not hold well in the soft ends of the ununited fragments. There-
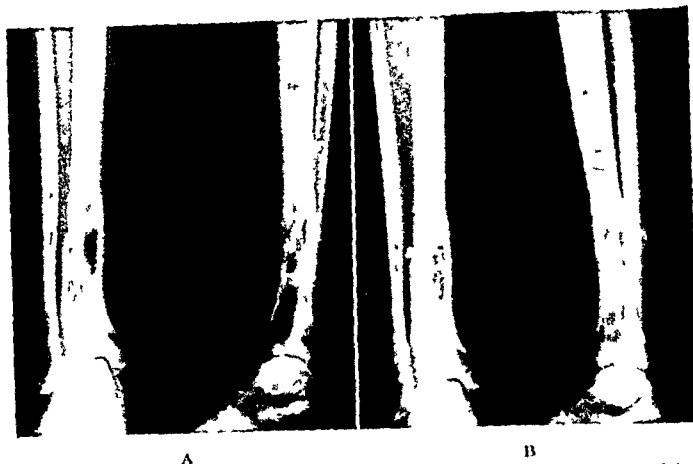
FIG. 13. Case XV. A, a large hole in the distal tibia was caused by a shell fragment in Normandy. B, it was curretted out and filled with chips from the crest of the ilium.

FIG. 14. Case XVI. A and B, a rifle bullet in the South Pacific caused the non-union of the first metatarsal. It was joined by a tibial graft.

modifications. For example, a fibula graft was being used to fill in a three inch defect in the ulna (Case V). Accurate steps were cut into both ends of the graft and the recipient bone ends. As the screws were being firmly seated into the distal ends, the recipient step broke off at a point which was discovered to have been fractured. Fixation was then obtained by adding a small four-screw ·plate which served perfectly well.

Rigid fixation of both ends of the fracture to the graft was the desirable objective whenever possible. Commonly the

fore, washers and nuts were often put on the screws to bind the soft bone ends tightly to the graft. When going through soft bone, the best grasp for the screw was obtained when it was inserted through the recipient bone first. Then the head of the screw, with a washer if necessary, snugged the soft bone against the hard graft. In fractures of the larger long bones better fixation was obtained by adding an oblique transfixing screw through another plane.

Steel wire through small drill holes has served well in a number of instances.

Metacarpal and metatarsal grafts were nearly always fixed by Kirschner wires, inserted sometimes transversely to bind to other metacarpals and at other times longitudinally. The ends were clipped off so that the skin closed over them. At the end of six to ten weeks they were removed under local anesthesia.

Plaster support was always desirable, at least for a time. The casts to the forearm or leg were usually split a few hours postoperatively in order to allow for swelling. At the end of two weeks they were carefully removed, the sutures taken out and a non-padded cast reapplied. The spica casts for the humerus and femur were left for several weeks but the sutures were removed through a window.

The difficulty of obtaining adequate fixation is illustrated by Case III. In this and another similar case the proximal ulna fragments angulated even though the arm was fixed in plaster from the axilla down. The triceps pull tended to angulate the proximal fragment backward and, in addition, the supinator rotated it. Therefore, it was found wiser to maintain these limbs in extension and supination. In the last case of this type this strain was effectually prevented by inserting a Kirschner wire longitudinally down through the olecranon on through the graft and into the shaft of the distal end. Angulation and rotation are always frequent headaches in both radius and ulna fractures, new and old, and require preventive measures.

ILLUSTRATIVE EXAMPLES

The cases shown here were selected to illustrate different problems in the nonunion of fractures of the long bones. They were chosen to show the variety of destructive bone lesions found in war injuries with the appropriate bone graft to answer each problem.

SUMMARY

1. A safe time interval of eight to sixteen weeks after all evidence of infection had ceased was followed.

2. Sufficient good skin with subcutaneous tissue was always needed to cover the bone.

3. A healthy vascular bed was prepared by excising scar tissue.

4. The tibia was the most common source of bone for grafting, but the iliac crest was often chosen when it could be used because of its better osteogenetic properties.

5. Many different types of grafts were selected according to the individual problem.

6. Rigid fixation was obtained by either bone carpentry, metal or both.

CONCLUSIONS

1. Bone grafts are of great practical value in correcting the gross defects of severe war injuries.

2. Good judgment and resourcefulness are needed by the surgeon to meet the variation in individual problems, both in the planning and execution of the operation.

3. The prime factors which should be carefully studied in each prospective case are: (1) timing, (2) skin surface, (3) bed, (4) source, (5) type, and (6) fixation.

4. If the prime factors are favorable, a successful take may be anticipated in practically every case.

THORACIC SURGERY IN THE FORWARD AREAS*

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CASUALTIES with thoracic injuries made up about 14 per cent of all wounded admitted to an American evacuation hospital during the first six months of the present campaign in Northern Europe. Of some 1,400 patients with chest injuries, about three-fourths had sustained missile wounds or blunt trauma to the chest wall alone or had manifested some degree of pulmonary blast injury. The majority of this group had other unrelated injuries which often were of greater moment than the thoracic wound. Some of the less seriously wounded were sent on without treatment to hospitals in the rear, where they could be operated upon with less delay than if they remained to wait their turn for operation following the more urgent cases. As a whole, this group of non-penetrating thoracic wounds presents no problems especially related to thoracic surgery in the forward areas and will not concern us in this communication.

Thoracic surgery in the forward hospitals is principally concerned with the definitive treatment of patients having penetrating or perforating wounds of the pleural cavity associated with hemothorax or pneumothorax, with special regard for those with open pneumothorax, concomitant abdominal involvement, and other complications. Roentgenograms of the chest were taken in the great majority of patients with chest injuries and nearly all patients with these more serious injuries were kept for treatment and observation. Since an evacuation hospital receives all types of injuries, we believe that our experiences with those with chest wounds represent a cross-section of the thoracic injuries encountered in this zone of combat.

Excluding some twenty-five patients who had been operated upon elsewhere and who were kept until their condition permitted evacuation to general hospitals, the number of patients with known intrapleural injury admitted was 380, representing 27 per cent of all those with wounds of the thorax. This communication deals with the management of this group during this critical phase of their hospitalization. The results given are necessarily based on the relatively short period of observation before their evacuation.

Sixty-nine per cent of the wounds were due to shell, mine, or grenade fragments, 28 per cent to bullets, and 3 per cent to blunt trauma, mostly due to vehicle accidents. There were no bayonet wounds. Gunshot wounds were somewhat more frequent earlier in the campaign, but recently shell fragment wounds have predominated in the ratio of 3:1 or more. The wounds were right-sided in 52 per cent, left-sided in 45 per cent, and bilateral in 3 per cent (ten cases). Penetrating wounds were about two and a half times as common as the perforating type.

PREOPERATIVE MANAGEMENT

The most important objectives in the preoperative care of these patients are: (1) to combat shock and to arrest hemorrhage if its source is accessible, (2) to close sucking wounds temporarily, (3) to alleviate pain and anoxemia, (4) to care for certain complications, especially tension pneumothorax, and (5) to recognize by physical and roentgenologic examination the extent of the thoracic injury and the severity of any associated trauma, especially that to the abdomen.

Shock was present in 37 per cent of the patients and was severe in 14 per cent.

Many of these patients had already received one or more units of plasma at advanced medical installations and in a few cases blood transfusions as well. Patients showing signs of shock were treated in a shock ward adjacent to surgery.

Stored Type "o" whole blood was preferred to that diluted with an equal volume of Alsever's solution, especially when it was thought that multiple transfusions would be necessary. The volume of fluid administered to chest casualties must be judged carefully and kept as small as possible and yet be adequate. Large volumes of intravenous fluids given to combat shock precipitated pulmonary edema in a number of patients with severe chest injuries, and probably contributed to the fatal outcome in a few of them. Most patients who required blood were given 500 cc. to 1,000 cc., usually with 500 cc. to 750 cc. of plasma as well. In cases with marked shock due to hemorrhage, it was not uncommon to give 1,500 cc. to 3,000 cc. of blood before and during operation. Recently we have been placing increasing reliance on serial hematocrit studies as well as on changes in the pulse and blood pressure readings as a guide to therapy.

In cases of continuing or increasing shock due to bleeding from the lung or parietal vessels, or from abdominal injury in the case of thoraco-abdominal wounds, after preliminary transfusion early surgical interference was considered to be the best treatment for shock. A pulse rate of over 130 beats per minute, or a systolic blood pressure of less than 100 mm. of mercury was not believed to be a contraindication to operation in such a situation. Bleeding from the chest wound or into the chest wall was rather common but it was only occasionally necessary to take steps to arrest it preoperatively.

In 29 per cent of the cases there was either an open pneumothorax present when the patient was admitted, or the wound sucked on debriding and retracting the soft tissues at operation. Two patients had bilateral sucking wounds and in four there were two sucking wounds on the same side. Usually the defect had been adequately sealed with an adhesive and vaseline gauze dressing before admission; but sometimes the latter had become loosened due to bleeding, or the diagnosis had been missed, and the wound would be found to be sucking under the original battle dressing when the patient coughed. Only rarely had such wounds been sutured as a first aid measure. The wounds were redressed after admission in every case and properly sealed.

About one-third of the patients showed moderate or severe dyspnea for which oxygen therapy was instituted. Chest aspiration was carried out preoperatively in 11 per cent of the cases, and in 34 per cent of the non-operative cases. Moderate sized collections of blood and air were not aspirated if the patient was reasonably comfortable.

Nearly all casualties had received ½ gr. of morphine tartrate after being wounded, but the full depressant effect of the drug was often not evident until they had begun to recover from shock. In five patients morphine poisoning was a serious problem and it was probably a contributory cause of death in four of them. If morphine was necessary for pain and restlessness it was given in small doses, ⅙ gr. hypodermically or ⅛ gr. intravenously. Most patients were disturbed from pain, dyspnea, anxiety, and the ambulance ride, and improved considerably after they had been propped up on a back rest and oxygen therapy started.

Hemothorax was evident in 81 per cent and was severe in 10 per cent of the cases. Pneumothorax was known to be present in 48 per cent and there were eight instances of tension pneumothorax present on admission. A few of the latter had had a needle equipped with a finger cot valve inserted as an emergency measure, but it was seldom functioning by the time the patient was admitted. In such cases a small catheter was usually inserted in the second anterior interspace and connected to a water seal bottle.

Dilatation of the stomach was fairly common in wounds of the left lower thorax associated with rib fractures, especially if abdominal involvement was present. Aspiration of the stomach was carried out in these cases, and in some instances the Levine tube was left in place during surgery for resumption of gastric suction on the postoperative ward.

Mobility of the chest wall due to multiple rib fractures was encountered several times and strapping with adhesive and placing the injured side down helped to relieve pain and dyspnea.

One patient had had an emergency tracheotomy before admission and it was performed in six others soon after admission. The indications were: bleeding into the fascial planes of the neck in three cases; perforation of the larynx or trachea in three; and a maxillofacial injury in the other patient.

The importance of the physical examination in estimating the severity of thoracic involvement and associated injuries does not need to be stressed. Paraplegia (eleven cases) and brachial plexus injury (eight cases) were watched for, since they had sometimes been overlooked in gravely injured patients. The frequency of involvement of the chest with wounds of the arm or shoulder must be kept in mind. Not infrequently, small entrance wounds in the chest are overlooked in the presence of a more noticeable perforating wound of the arm. Moreover, patients with penetrating wounds of the arm or shoulder revealing no foreign body in roentgenograms should have chest films as well. Interesting but less important was the detection of phrenic nerve paralysis (two cases) and injury to the recurrent laryngeal nerve (two cases).

The frequency of concomitant abdominal injury in wounds of the lower chest, and conversely of intrathoracic damage in upper abdominal wounds, must be kept in mind. Involvement of the diaphragm or abdominal structures was present in 22 per cent of this series of 380 patients with penetrating and perforating wounds. The diagnosis was sometimes easy because of the location of the wounds or was facilitated by the presence of such diagnostic complications as hematuria, evisceration, hematemesis, or biliary or gastric drainage from the chest wound.

In penetrating wounds of the chest or abdomen not infrequently the missile was seen imperfectly or not at all in the roentgenograms of one body cavity and the patient had to be returned for films of the other. Reconstruction of the course of the missile from its entrance to point of lodgment or exit was essential in order to predict organ involvement and to plan the operative approach.

Anteroposterior and lateral roentgenograms of the chest taken usually in the sitting position were made in nearly every case in which penetration of the pleural cavity was a possibility. Due to technical difficulties the lateral films were sometimes unsatisfactory; and if it was important to know the location of the foreign body, the Potter-Bucky grid was employed for additional films. A few patients with perforating wounds were operated upon without films because of the obvious and severe nature of their injuries. Roentgenologic evidence of blood aspirated into the tracheobronchial tree and of intrapulmonary hematoma was common. In about 4 per cent of the cases the latter was not associated with any appreciable hemothorax or pneumothorax. Atelectasis of varying severity was diagnosed from the admission roentgenograms in 9 per cent of the patients, in a few of whom portions of the uninjured lung were collapsed. Rib fractures were known to be present in 45 per cent and over one-third of these had fractures of more than one rib. In addition, fractures of the scapula (7 per cent), vertebra (4 per cent), and clavicle (3 per cent), were not uncommon. Complete fracture of the sternum was encountered only once.

The diagnosis of pulmonary blast injury was made in ten instances from the history

of proximity to the shell explosion, the presence of bilateral findings in the roentgenograms, and the evidence of dyspnea and cyanosis out of proportion to the severity of the chest wounds. These patients seemed especially prone to develop signs of pulmonary edema, and when fluids were necessary for the treatment of shock, whole blood and hypertonic plasma were preferred. General anesthesia could not be avoided in most of these cases because of the associated injuries or because thoracotomy had to be done, but local procaine infiltration and regional blocks were carried out when possible.

Other complications diagnosed from roentgenograms included mediastinal emphysema in three cases and widening of the mediastinum due to bleeding in two. Obstructive emphysema of the lung due to intrabronchial foreign bodies was suspected in two patients who died, but unfortunately they were in too poor condition to be bronchoscoped.

Because of the use of Type "o" stored blood and the large numbers of multiple transfusions given, chill reactions occurred five times preoperatively, followed in one case by temporary renal shutdown.

Apart from concomitant abdominal wounds, associated injuries were present in 46 per cent of the patients in this series and were severe in 9 per cent. In the latter category were included eleven cases of spinal cord injury, nine with a compound fracture of the femur, and ten with a compound fracture of the humerus or tibia plus one of the following: skull fracture, extraperitoneal perforation of the rectum, or gangrene of an extremity.

Intramuscular penicillin therapy in dosages of 20,000 units every 4 hours was instituted on admission. Intravenous sodium sulfadiazine was given to some patients who could not be given the drug by mouth.

The time interval between wounding and admission varied considerably depending on the tactical situation but averaged about eight to twelve hours. The interval between admission and operation also varied widely, depending on the severity of the patient's wounds, his response to shock therapy, and the press of other urgent cases on the surgery schedule. Those with an open chest wound or suspected abdominal penetration had priority, but even so the average stay on the preoperative or shock ward for all cases was ten to eleven hours. When the "backlog" of priority cases was large, less seriously wounded chest casualties had to wait twenty-four to thirty-six hours or more for operation.

This delay was not altogether a bad thing and in some cases it was imposed intentionally. If a sucking wound was well sealed and there was no compelling indication for immediate surgery, it was considered to be time well spent to let the patient rest, so that his respiratory and circulatory physiology could adjust itself to changes in blood volume and intrapleural pressure brought . about by the injury and blood replacement therapy.

PATIENTS NOT OPERATED UPON

Before discussing the operative treatment of these patients we should first deal with the sizable group of 60 cases for whom no operation was thought to be indicated in the forward hospital and with the twenty-eight patients who died without surgery.

Of the latter group, eighteen died twelve hours or less after admission. The most important cause of death was shock which did not respond to treatment. Overdosage of morphine, pulmonary edema, and anoxia were contributory causes in other cases. Ten of the twenty-eight had associated injuries which in themselves were serious. Death was due to respiratory paralysis following transection of the cervical spinal cord in one instance and to injury of the internal carotid artery with hemiplegia in another. One patient aspirated pleural fluid through a bronchopleural fistula and died suddenly of asphyxia. Except in such desperate cases, however, every attempt was made to bring severely wounded patients to surgery in the hope that arrest

of hemorrhage, closure of a sucking wound of the chest, and evacuation of a large hemopneumothorax might offer a chance of recovery. Several patients died during or immediately after such attempts, but others with an almost equally bad prognosis survived.

Of the sixty patients who were evacuated without surgical treatment, seven had sustained closed injury to the chest wall associated with rib fractures and a small hemothorax or pneumothorax. Taping of the chest and intercostal nerve blocks were carried out and the patient observed for twenty-four hours or more before being evacuated. There were thirty-one patients with gunshot wounds in this group, most of them perforating and not associated with significant rib damage. There were twenty-two patients with small, clean shell fragment wounds which did not require débridement. Three of the latter were thoraco-abdominal wounds. In two of them small shell fragments were present in the liver, with a minimal hemothorax. In the third patient, a French girl, there was sero-purulent and biliary drainage from a right-sided six-day old wound, associated with an infected hemothorax and shell fragments in the liver. She was treated with chest aspirations and intrapleural penicillin therapy until her evacuation to a civil hospital. Chest aspiration was carried out one or more times in twenty-one of these sixty patients, and closed catheter drainage of the chest for suspected bronchopleural fistula in two of them. Most of them were kept for twenty-four to seventy-two hours, i.e., until it seemed unlikely that active intrathoracic bleeding or tension pneumothorax would develop.

OPERATION

Two hundred ninety-two patients were operated upon of the total of 320 needing operation, an operability rate of 91 per cent. The thoracic operations performed in 222 cases with no abdominal involvement were of three types: (1) minor procedures, (2) thoracotomy, (3) other major proced-

ures. Additionally, we shall consider separately the operative procedures for seventy patients with combined injuries of the thorax and abdomen.

Minor procedures included wound débridement and exploration, aspiration or intubation of the chest, and removal of foreign bodies from the chest wall. They were carried out in 123 cases in which rib resection, closure of the pleura, or thoracotomy did not seem necessary. Aspiration of the chest was carried out preoperatively or at operation in forty-five cases and postoperatively only in another seventeen patients. Closed intercostal drainage of the pleural cavity was instituted in nine other patients. The latter was done not only in cases of tension pneumothorax, but was also preferred for the removal of a large hemopneumothorax. By clamping the catheter intermittently, large accumulations of blood and air were evacuated gradually and a safeguard against respiratory embarrassment due to further bleeding or accumulation of air was assured. In addition, less difficulty was encountered with clotting and loculation of intrapleural blood if the pleural cavity was kept as empty as possible.

If the hemopneumothorax was not causing much dyspnea at the time of operation, its removal was often deferred twenty-four hours, since it was thought that immediate aspiration might re-expand the injured lung too soon and lead to further bleeding. On the other hand, no one was evacuated who was known to have a sizeable hemothorax even if he had no dyspnea, because of the well known dangers of delayed absorption, clotting, infection, and unre-expanded lung. When a large hemothorax was aspirated with a needle, it was usual to take out 600 to 800 cc. at the first tap and the rest twelve to twenty-four hours later. Air replacement was never carried out; 40,000 units of penicillin in 20 to 30 cc. of saline were injected after each aspiration and also at the time of removal of a chest catheter. Closed drainage was usually continued thirty-six to forty-eight hours

after operation unless the persistence of an open bronchopleural fistula necessitated its continuation.

There were nine postoperative deaths in this group of minor procedures, an operative mortality rate of 7 per cent. Seven of them had severe associated injuries. Another had blast injury of the chest and abdomen, and died with pulmonary edema the day following laparotomy for what was believed to be a penetrating wound of the abdomen. Blast injury was also present in the seventh patient, who died with bilateral bronchopneumonia and obstructive emphysema in the right lung, the latter apparently due to an intrabronchial shell fragment. He should have been bronchoscoped early but the etiology of his signs and symptoms was not recognized until too late.

We have reserved the term thoracotomy for those operations in which the chest was widely opened for inspection and other procedures within the thorax. We considered the principal indications to be as follows: (1) large sucking wounds with fractures of one or more ribs, especially if there were indriven fragments; (2) large hemothorax due to continuing bleeding from the lung or parietal vessels; (3) suspected diaphragmatic hernia and concomitant upper abdominal injury; (4) suspected wounds of the heart or other mediastinal structures; and (5) large intrapleural foreign bodies. Commonly, more than one indication was present, and the combination of an open pneumothorax with a large hemothorax and retained shell fragment was frequent.

Thoracotomy was performed in 104 cases. In forty-two of these concomitant wounds of the chest and abdomen were present, and this group will be discussed later. In the sixty-two remaining cases shell fragment wounds outnumbered bullet wounds 4:1.

The thoracotomy incision was usually made over the fractured rib and included the wound of entrance, which was excised. The exposure was nearly always adequate and elective incisions were seldom made.

Rib fractures, often multiple and comminuted, were present in 89 per cent of the cases. In the rest, thoracotomy was performed through an intercostal incision.

The wound was sucking on admission or at surgery in fifty of the sixty-two cases. This was not considered to be an indication for thoracotomy *per se;* small defects were simply sutured. Suture of the lung was performed in twenty-five instances. Metallic fragments were removed from the lung in five cases, from the pleural cavity in four, from the pericardium in two, and from the anterior mediastinum in two. Of some sixteen intrathoracic missiles which by roentgenograms measured 1.5 cm. or more in two dimensions, ten were removed. No time was lost in searching for smaller fragments if they could not be readily found. In addition, bits of clothing and rib fragments were removed from the lung in a number of cases. Ligation of a lacerated internal mammary artery was carried out once. We did not believe that pulmonary resection was indicated in the cases in this group.

There were two patients with wounds of the heart. In one a large fragment had perforated the left upper lobe of the lung, traversed the upper wall of the left ventricle, and lodged within the pericardium anteriorly. There was a large hemothorax without any cardiac tamponade. The foreign body was removed and the heart, pericardium, and lung sutured through a lateral thoracotomy incision. The patient developed a small empyema pocket with a pleurocutaneous fistula postoperatively, but was in good condition on evacuation. The other patient had a penetrating wound of the left auricle and pulmonary vein, and died at operation.

A No. 18 French catheter was inserted for dependent closed intercostal drainage in nearly every case. Before the chest was closed the anesthetist was asked to re-expand the lung with positive pressure. This was not always satisfactory and air was aspirated from the chest catheter after closure in some instances. Latterly, we have

found that larger catheters are more satisfactory (No. 20 or No. 22 French).

Pericostal sutures were sometimes utilized and were very helpful in the closure. Pedicled muscle flaps were sutured into large pleural defects. The muscles were closed in layers and the skin approximated with interrupted silk sutures, including the débrided wound of entrance or exit in most cases, especially if it had been sucking. The wound of entrance was not closed if there had been a long time lag between wounding and operation, however.

There were eleven deaths among the sixty-two patients in this group subjected to thoracotomy for intrathoracic injuries, exclusive of the thoraco-abdominal group. Eight of them had moderate to severe unrelated injuries, and two died of uremia due to renal shutdown following blood transfusion. The patient with a fractured sternum developed a tension pneumothorax postoperatively which was not adequately decompressed by his posterior catheter.

In thirty-seven thoracic operations short of thoracotomy were carried out which were more serious than simple wound débridement and aspiration. Commonly an exploratory incision was made, fractured rib segments removed if necessary (eleven cases) and an open pleural defect closed (twenty-nine cases). Rib fractures were present in twenty-two cases, but in half of them no resection was necessary because the fractures were incomplete or not comminuted. Retained intrathoracic foreign bodies were usually small, but in a few instances they exceeded 1.5 cm. Some of these patients were candidates for thoracotomy at the base hospital at a later date. An intercostal catheter was inserted in seventeen cases and postoperative chest aspiration carried out in several other instances. There were no postoperative deaths in this group.

COMBINED INJURIES OF THE CHEST AND ABDOMEN

There were eighty-three cases in this category, representing 22 per cent of the 380 chest cases reported, and 24 per cent of those with penetrating abdominal wounds admitted during the same period.

We found the following descriptive classification to be convenient:

(1) The term *thoraco-abdominal* wound was used to designate those in which the missile entered the pleural cavity first, traversed the diaphragm, and lodged in or traversed the peritoneal cavity. This was the largest group with fifty-three cases and seven deaths. (2) The term *abdomino-thoracic* wound was reserved for those in which the abdomen was penetrated first, then the chest. Of the thirteen cases in this group six died, an indication of the more serious prognosis of this type. (3) *Thoraco-retroperitoneal* wounds involved the chest, diaphragm, and retroperitoneal structures (commonly the kidney) without apparently entering the peritoneal cavity. There were six such cases with one death. (4) The term *thoracic and abdominal injuries* was applied to those in which there were separate missile wounds of both cavities (seven cases); subcutaneous injury to chest and abdomen by blunt trauma (two cases); and missile wounds of one body cavity associated with blunt injury to organs of the other (two cases). This group had the highest mortality rate, with eight deaths among the eleven cases.

Right-sided wounds outnumbered the left-sided injuries 48:33, and in two cases the chest and abdominal wounds were on opposite sides of the body. In about three-fourths of the cases the causative agent was a penetrating shell fragment, and in one-third an open pneumothorax was present.

We have already discussed in the section dealing with patients not operated upon thirteen of these eighty-three patients with combined thoracic and abdominal injuries. In the seventy operated cases five principal types of procedures were performed: (1) thoracotomy with transdiaphragmatic operation, (2) thoracotomy combined with laparotomy, (3) laparotomy alone, (4) exploration of the kidney, and (5) minor

operations. We believed that the decision to operate through the thorax, abdomen, or both should be dictated by certain indications rather than by the surgeon's personal preference for working in either the chest or abdomen.

The selection of thoracotomy and trans-diaphragmatic operation, for example, should be based on the presence of sufficient thoracic involvement to warrant opening the chest, rather than on the type and extent of abdominal involvement. Fortunately, the three abdominal organs most frequently involved, the liver, stomach and spleen, are for the most part accessible to transdiaphragmatic exploration and repair and, in fact, are more easily operated upon through the thorax than by celiotomy. Closure of high perforations of the stomach, splenectomy, and repair of diaphragmatic hernia can be performed with much greater facility through the diaphragm.

A posterolateral thoracotomy incision was usually made. In the thirty cases subjected to thoracotomy and transdiaphragmatic operation, resection of fractured rib segments was carried out in two-thirds of the cases and intercostal thoracotomy performed in the other one-third. Suture of the lung was carried out eight times and foreign bodies were removed from the lung or pleural cavity in five cases. A diaphragmatic hernia was repaired in seven patients. Phrenic emphraxis was done only once, since function of the diaphragm in re-expansion of the lung seemed more important than other considerations; 100,000 units of penicillin were injected into the catheter at operation and the tube clamped for several hours if there had been much contamination of the pleural cavity.

The usual abdominal injury in the sixteen right-sided cases was a penetrating wound of the liver, which was explored and sutured if necessary, or packed and drained by stab incision of the abdominal wall, made working through the diaphragm. In the fourteen left-sided cases transthoracic repair of the stomach was performed six

times and splenectomy seven times. Once thoracotomy with removal of a shell fragment in the lower lobe of the lung was carried out through a kidney incision after suture of a lacerated kidney. In another transdiaphragmatic suture of the upper pole of the kidney was done. There were seven postoperative deaths among the thirty patients in the group. Shock was the usual cause, but two died with empyema, in one case associated with gangrene of a lower lobe of the lung, and another with a massive pulmonary hemorrhage.

Thoracotomy and transdiaphragmatic operation was performed along with laparotomy in twelve cases, either through the same incision (seven cases) or through separate incisions (five cases). The operation calculated to do the patient the most good was performed first, i.e., thoracotomy in most instances. The decision to explore the abdomen following thoracotomy depended primarily upon the presence of perforation of the intestine, or of injury to upper abdominal organs which proved to be inaccessible to the transdiaphragmatic approach. In seven cases exploration and repair of both cavities were performed through a single incision in the flank or lower thorax anteriorly, or through a kidney incision extended to the flank. The attachment of the diaphragm to the chest wall had been torn in most of these cases and had to be sutured at the end of the thoracic operation. Some of the injuries in this group of twelve cases were quite extensive. In one patient successfully operated upon, perforations of the stomach and of the left lower lobe of the lung were sutured, a laceration of the liver sutured, and a diaphragmatic hernia repaired at thoracotomy. At laparotomy six inches of gangrenous jejunum were resected and an end-to-end anastomosis performed; a perforation of the jejunum was sutured; and exteriorization of a perforated portion of the transverse colon was carried out. Transdiaphragmatic repair of the stomach and transdiaphragmatic splenectomy were done twice in this group.

Three of the twelve patients subjected to combined operations died, two of them on the operating table where an attempt had been made to control hemorrhage.

Laparotomy alone was performed in eighteen patients in whom the thoracic injury was minimal. The chest wound was débrided, the pleura closed if it was found to be open, and the hemothorax aspirated if necessary. Closed intercostal drainage was carried out in four cases in which the hemothorax was large or where contamination of the pleural cavity by gastric content was likely. Suture or packing of liver wounds was carried out in seven cases; repair of stomach in six; splenectomy, suture of the small intestine, and exteriorization of the large intestine each in three cases, and end-to-end anastomosis of the small intestine and suture of the kidney once each. There were two deaths among the eighteen patients in the laparotomy group.

Exploration of the kidney with suture of the kidney and diaphragm was done in three patients with thoracoretroperitoneal wounds. The thoracic injury in this group also was slight, and considerable hematuria was the indication for operation. All three recovered.

The last category, miscellaneous minor procedures, included seven patients with minimal concomitant thoracic and abdominal injury, in whom the indications for one of the major procedures discussed above were not present. Typically, there was a small wound of the thorax associated with a small hemothorax and liver injury due to a perforating bullet wound or a small penetrating shell fragment. In one case the kidney was involved, and in another the pleural and peritoneal cavities had been opened without visceral damage. In three small tears of the pleura were closed. One left-sided case with a hemothorax and subdiaphragmatic bleeding, presumably from the spleen, was treated conservatively with some misgivings. Ordinarily conservative management has no place in left-sided

wounds. There were no postoperative deaths in this group.

In summary, there were twenty-two deaths in the eighty-three patients with combined injuries of the abdomen and thorax, a fatality rate of 27 per cent. Twelve of the seventy patients operated upon died, a mortality rate of 17 per cent. Five of these deaths occurred among the forty right-sided cases and seven among the thirty patients with left-sided wounds. Perforation of a hollow viscus was associated with an operative mortality rate of 32 per cent. When a solid viscus alone was involved the rate was 11 per cent. One death occurred among the five patients in whom the diaphragm alone was involved.

ASSOCIATED INJURIES

Apart from abdominal involvement, the frequent association of unrelated injuries (46 per cent of all cases) presented problems in judgment in the more seriously wounded. In some the associated compound fracture or head injury was more serious than the chest wound. In others, the patient with a serious chest or thoracic and abdominal wound was in such poor condition following operation that operation on an extremity had to be delayed for twenty-four to seventy-two hours. The danger of development of serious infection was thought to be less than that of subjecting a patient already in shock to further trauma and blood loss.

Fractures of the humerus and shoulder girdle were common in this group, and their immobilization presented difficulties if the necessary chest examination and aspiration were to be carried out. In some a plaster Velpeau dressing was applied and a window cut in the cast for the chest catheter and for subsequent aspirations if required. Many had temporary Velpeau type dressings of elastic bandage or adhesive during the early postoperative period, and a plaster Velpeau or thoracobrachial cast was applied for transportation. In some cases with fractures of the

supracondylar portion or shaft of the humerus, a full arm cast was applied temporarily and a suitable type for transportation substituted before evacuation.

ANESTHESIA

The preoperative medication for general anesthesia was $\frac{1}{6}$ gr. of morphine sulfate with $\frac{1}{100}$ gr. of atropine sulfate given intravenously. Morphine was omitted if the patient was in poor condition, or if it had been given within four to five hours. In cases in which thoracotomy was not required, operation was often performed with the patient on the litter. A slow infusion of blood or plasma was started in the more seriously wounded.

In about half the cases, the anesthetic agent was a nitrous oxide-oxygen-ether mixture given through an endotracheal tube. Sodium pentothal given intravenously (usually supplemented with nitrous oxide and oxygen inhalation), ether, and procaine injected locally or for regional block were each employed in about one-sixth of the cases.

Ether anesthesia administered through a large endotracheal tube was used both for thoracotomy and for laparotomy, because the airway was assured, respiration could be controlled, upper abdominal relaxation was improved, and aspiration of tracheo-bronchial secretions during and after surgery was facilitated. Patients in poor condition at the end of operation were left on the operating table for an hour or more while the administration of oxygen and blood was continued.

POSTOPERATIVE MANAGEMENT AND COMPLICATIONS

Oxygen therapy was continued on the postoperative "chest and abdomen" ward for several hours in most major cases, along with infusion of blood or plasma if indicated. Gastric suction was instituted in most cases with abdominal involvement, and also in a number of patients with left-sided thoracic injuries associated with gastric distention. Penicillin and sulfa-diazine therapy were continued, usually throughout the patient's stay. Intravenous sodium sulfadizaine was given to some patients who could not take the drug orally, especially if such indications as atelectasis, bronchopneumonia, or gross contamination of the pleural cavity existed.

The patency of the chest catheter was checked at intervals, and it was ordinarily removed in thirty-six to forty-eight hours, after injecting 40,000 units of penicillin in saline.

Reaccumulation of serosanguineous fluid was usual after removal of the catheter, and many patients required one to four chest aspirations with intrapleural injection of penicillin each time. Small collections of fluid were not removed unless empyema was suspected. Empyema occurred in six cases subjected to thoracotomy and in another treated by débridement and aspiration. Other cases of empyema and non-re-expanded lung probably appeared after patients had left our care, of course. The same is true of wound infection, the incidence of which following major procedures was 6 per cent.

Precautions were taken to decrease the frequency of postoperative atelectasis, which appeared in some degree in about 8 per cent of the cases, and to encourage re-expansion of the lung. Breathing exercises were started early, and patients were encouraged to sit up if possible on the third or fourth day after thoracotomy, and to get up and about soon afterward.

Anteroposterior and lateral chest films were taken on the fourth or fifth day following major procedures.

There were six instances of tension pneumothorax developing after operation. Other pulmonary complications were frequent; some of these were broncho-pneumonia, pulmonary edema, bile in the pleural fluid, bronchopleural fistula, and severe hemoptysis. There was one instance of each of the following: pulmonary embolus, mediastinitis, lung gangrene, persistent auricular tachycardia, and respiratory failure due to high transection of spinal cord.

Postoperative transfusion reactions were all too frequent (ten cases). Three were of the severe hemolytic type and led to uremia and death; one showed temporary renal shutdown only. A toxic psychosis, probably precipitated by pain and anoxia, occurred in three patients. Four cases of mild peritonitis due to spillage from perforations of the stomach or intestine, and two due to bile in the peritoneal cavity, were seen. In three cases biliary drainage through the abdominal wound persisted. There were two instances of wound disruption in the thoracotomy group. One patient with an abdominothoracic wound developed a fecal fistula alongside his colostomy opening. There were no deaths from peritonitis in those with abdominal injury.

EVACUATION

While we were sometimes compelled to transfer patients to the care of another hospital unit before they were ready to be evacuated, our usual policy was to hold post-thoracotomy cases for about a week and post-laparotomy patients for at least ten days. The continuing admission of large numbers of casualties at times induced us to evacuate cases we would ordinarily have held for another two or three days. Many patients were evacuated by air. It was believed that air transport at low altitudes was preferable to that by ambulance and ship, and would do no harm if the patients had been properly selected.

COMMENTS

We have reviewed the clinical findings and treatment in 380 cases of wounds of the chest involving hemothorax and pneumothorax. Thoracic surgery in forward hospital units is especially concerned with the treatment of patients with open pneumothorax, concomitant abdominal injuries, or evidence of severe injury to the lung, chest wall, or mediastinum.

Sixty patients required no treatment in the forward area except aspiration or strapping of the chest. Twenty-eight patients, many of whom had serious associated injuries, died without operation. Of the 292 patients operated upon, seventy had concomitant trauma to the abdomen.

Among the 222 operated cases who had no abdominal injury, 123 had minor procedures, sixty-two were subjected to thoracotomy, and thirty-seven to other major procedures. Adding the forty-two thoracotomies performed in the group with combined injury to the chest and abdomen, thoracotomy was performed a total of 104 times, or in 36 per cent of all operative cases. The general operative mortality in the 222 cases was 9 per cent and that for the 104 thoracotomies, 20 per cent.

In the latter half of the campaign we tended to perform a higher proportion of thoracotomies. In a few cases it was probably done unnecessarily where wound débridement, closure of the pleura, and aspiration or intubation might have sufficed. In two cases, on the other hand, minor operations proved to be inadequate and the patients had to be returned to surgery for thoracotomy. We have also tended to carry out closed catheter drainage more often in cases with moderate to severe hemopneumothorax, even if the chest was not opened. Operative experience has increased the proportion of foreign bodies found and removed at thoracotomy. Time is saved if elective thoracotomy incisions are avoided, since exploration of the chest at the level of the entrance wound is usually adequate.

In regard to preoperative management, we have learned to be more cautious in giving a large volume of fluid to severely injured chest casualties. Time as well as the patient's strength is saved if both anteroposterior and lateral roentgenograms of the chest are ordered in all cases in which penetration of the pleural cavity is a possibility, and roentgenograms of the abdomen as well where any suspicion of abdominal involvement is entertained.

The availability of stored bank blood has been a tremendous aid but it is not an

unmixed blessing since serious transfusion reactions were not infrequent.

While bronchoscopic aspiration was performed at the end of operation several times, usually catheter aspirations through the endotracheal tube sufficed. Bronchoscopy was done only occasionally for atelectasis in the postoperative period.

SUMMARY AND CONCLUSIONS

1. Three hundred eighty patients with chest injuries associated with hemothorax or pneumothorax were admitted to an evacuation hospital in a six-month period. The clinical findings and preoperative and postoperative management of these cases have been discussed.

2. The general mortality rate for the 380 patients was 16 per cent. Twenty-eight patients died without operation and sixty were evacuated without operation.

3. The general operative mortality rate among the 292 operated cases was 11 per cent.

4. In the 222 patients with thoracic injuries not complicated by abdominal injury the operative mortality was 9 per cent.

5. The operative mortality rate for the 104 patients subjected to thoracotomy was 20 per cent.

6. Eighty-three patients had combined injuries of the thorax and abdomen; the operative mortality rate for the seventy patients in this group was 17 per cent.

7. One hundred seventy-five patients (46 per cent) had other associated injuries of varying severity.

DATA IN 380 CASES WITH CHEST INJURY ASSOCIATED WITH HEMOTHORAX AND PNEUMOTHORAX

	No. of Cases	Per Cent of Total	No. Lived	No. Died
Non-operative cases				
(1) Thoracic injury...	75	19.8	57	18
(2) Combined thoracic and abdominal injury............	13	3.4	3	10
Operative cases				
(1) Thoracic injury: totals:...........	222	58.4	202	20
(a) Minor procedures........	123	....	114	9
(b) Thoracotomy.	62	....	51	11
(c) Other major procedures....	37	....	37	0
(2) Combined thoracic and abdominal injury: totals:......	70	18.4	58	12
(a) Miscellaneous minor procedures........	7	....	7	0
(b) Exploration of the kidney....	3	....	3	0
(c) Laparotomy alone........	18	....	16	2
(d) Thoracotomy and transdiaphragmatic operation.....	30	....	23	7
(e) Thoracotomy with laparotomy.........	12	....	9	3
Totals......	380	100.0	320	60

ANESTHESIA FOR OPEN CHEST SURGERY*

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OWING to the many problems imposed by the surgical opening of the chest, both surgery and anesthesia in this field have only recently begun to make progress comparable with that in other regions of the body. The problems imposed by intrathoracic surgery have been well defined by several investigators.[1-5] One of the most important, surgical pneumothorax, has always been the bugbear of both the surgeon and the anesthetist. The responsibilities of the anesthetist have been stated repeatedly to include his ability to inflate, at will, both sides of the chest. Devices to accomplish this effect have included the use of alternating pressure operating rooms, endotracheal insufflation (respiration without respiratory movements), and finally the use of the wide bore endotracheal tube for endotracheal inhalation.

Endotracheal intubation has been stated by many modern workers[5-10] to be essential in open chest anesthesia. The advantages obtained by the use of the endotracheal tube are many and include, in this field, the following:

1. It assures, in the absence of kinking or twisting of the tube, an airway at all times.

2. It renders artificial respiration simple.

3. It prevents the patient from straining or coughing to a large extent; that is, he is unable to build up high intrabronchial pressures, as the glottis cannot be closed.

4. It makes possible and easy the repeated aspirations of the trachea that are so essential to proper anesthesia for "wet-lung" surgery.

5. It keeps oxygen and anesthetic gases out of the stomach, a great advantage when positive pressure and controlled respirations are employed.

6. It permits aspiration of the pharynx without interrupting the anesthesia.

7. It reduces dead space in an individual whose facility for oxygenation is already lowered.

8. It prevents (with a tight fit) passage of secretions into the trachea.

9. It allows the use of positive pressure.

10. It helps to create a gas-tight system.

11. It makes possible surgery in the prone and lateral positions.

12. It saves expense; of great importance in the use of cyclopropane, considered by many[6,11,12] to be the ideal anesthetic agent in these procedures.

13. It produces flaccid and adequate respiration.

14. It reduces bleeding, an important consideration in an operation associated with much blood loss.

15. It renders controlled respiration simple and efficient.

16. It eliminates the necessity of holding the mask during the entire anesthesia, freeing the anesthetist's hands and eliminating the large leaks often present when holding the chin or fitting the face is difficult.

17. It eliminates the danger of trauma to the face by the mask pressure.

Endobronchial intubation has been suggested.[3,4,12] The anesthetic mixture can be delivered to one main bronchus (one lung anesthesia) or a suction catheter may be placed in a main bronchus or in a lobe bronchus, while respiration takes place through an endotracheal tube. Endobronchial anesthesia was introduced by

Waters.[4] It is not widely used, as it is fraught with technical difficulties, is time-consuming and uncertain.

The inflatable cuff surrounding the endotracheal tube has been the subject of much discussion; its use is favored by many.[7,13] Its effect is to seal off the space between the outside of the tracheal tube and the inside of the trachea and thus to insure a gas-tight system, a great advantage when positive pressure or controlled respirations are desired. Many workers[8,14] have objected to its use. Its disadvantages are twofold: Sustained pressure in the cuff has been known to be followed by necrosis of the larynx; and it prevents the drainage of secretions down the trachea and into the pharynx, around the tracheal tube. This latter has been asserted by many to be of prime importance as contamination from the diseased lung to the sound lung is facilitated by the position generally employed for these procedures; the possibility of such contamination is naturally greater when secretions are dammed back by the inflated cuff. Some workers[6] believe the use of the cuff to be optional.

The surgical pneumothorax imposes on the surgeon and anesthetist problems of reduced oxygenation, mediastinal flap, collapse of a lobe or lobes that may require re-expansion, and paradoxical respiratory movements on the operated side.

Other problems confronting the anesthetist and associated with intrathoracic surgery include the following:

1. The general health of these patients is often poor since they are commonly suffering from bronchiectasis or malignancy, and hypoxia.

2. Open-chest operations are often shocking procedures.

3. Both oxygen absorption and absorption of anesthetic gases are reduced before surgery; the latter often renders induction slow.

4. Unfortunately, the position that is ideal for the surgeon imposes a severe handicap on the patient, who is usually placed in a lateral position, with the head down. This facilitates cross-contamination, as has been pointed out. The effect of the lateral position is to hamper the respiratory movements on the sound side.[1] It has been demonstrated[7] that at least 35 degrees of head lowering are required to avoid inter-lung spread. The effect of the head down position, in half this amount, is to inhibit pulmonary exchange. Excessive Trendelenburg position fails to protect the apices from secretions in lower lobe bronchiectasis. It has been shown[15] that the Trendelenburg position elevates the diaphragm and thereby lowers the functional residual air, causing atelectasis. These factors tend, in the intact chest, to raise intrapleural pressure, impairing respiration and impeding the return of blood to the heart.

5. Contamination of the sound lung has already been discussed.

6. Respiratory obstruction may develop due to the presence of pus or blood in the trachea and bronchi.

7. It is essential, in these procedures, that the patient not be allowed to cough or strain. It has been pointed out[16] that coughing can spread contaminating material to the undiseased lung or lobes. It is constantly being pointed out by the surgeon that straining renders more difficult his already difficult work in so dangerous an area.

8. Finally, pneumothorax is attended by mechanical effects on the lungs, heart, and great vessels. The usual changes in intrathoracic pressure associated with normal respiration are here completely lacking.

9. The combined effects of lateral position, lowering the head,[17] and changes in intrathoracic pressure have been shown to favor the formation of interstitial pulmonary edema; this has been demonstrated repeatedly in this hospital, clinically and roentgenologically.

Many different drugs and varied technics have been advocated by different anesthetists. Ether has been recommended as the drug of choice.[6,8,18] Cyclopropane

seems now to be the anesthetic agent most commonly used in lobectomies and pneumonectomies.[11,12] Nitrous oxide, ethylene, pentothal and avertin (in combination with other drugs) have been used in the past. Regional anesthesia has been used by some.[18,19] However, it is generally believed that the patient is better kept asleep for such procedures. Spinal anesthesia[8] does not leave the cough reflex

the patient's circulatory and respiratory signs. Our technic includes a slight deepening of the anesthesia at the moment of opening the pleura and readiness to control the respirations immediately, but the patient is often allowed to breathe unassisted. Some authors[2,4,22] have advised a preliminary pneumothorax, to avoid what they consider a severe embarrassment to the lungs and heart attending the

TABLE I

	1935	1936	1937	1938	1939	1940	1941	1942	1943	1944	1945	Total
1. Anast. esophagus										2	1	3
2. Att. rem pulm embolus			1									1
3. Biopsy mediast. tumor							1			2		3
4. Cautery pneumonectomy		1										1
5. Cauteriz'n lung abscess		1										1
6. Decortication emp. cavity						1						1
7. Esophagectomy				2	1	1		2				6
8. Exc. hygroma chest									1	1		2
9. Exc. mediast. tumor					1	2		1	1	1	2	8
10. Exc. pericard. cyst							1					1
11. Ext. ca. esophagus			1			1	1					3
12. Intrathoracic thyroidectomy							1					1
13. Ligation esophagus						1		3	5	1	2	12
14. Lig. pat. duct. art					1	1	1	2	10	2	1	18
15. Mobilization esophagus					1	1						2
16. Pericardiectomy				1		1	2	2	1	1		8
17. Pneumonolysis		1	1				1					3
18. Pneumonectomy			2	2	2		1	2	6	8	3	26
19. Pulm lobectomy	1		2	2	1	3	5	5	5	8	1	33
20. Rem bullet from lung				1								1
21. Repair diaph. hernia				1	1	1	4	1	2	1	2	13
22. Transthoracic exploration			1		2	2		2		15	1	23
23. Transthoracic gastrectomy									3	1	1	5
24. Transthoracic gastrostomy										3		3
Total	1	3	10	8	12	21	13	17	33	46	14	178

intact, as the chest is open; it renders bronchial suction and intubation difficult; its mortality figures are probably not good.

The carbon dioxide absorption technic is employed universally for intrathoracic surgery.[11,12] The results of surgical pneumothorax have been discussed above; respiratory embarrassment, it has been stated,[20] is often pronounced when the pleura is opened; the mediastinum at this time moves toward the intact side,[21] tending to collapse that lung, too. It has been our experience, however, that opening the pleura is associated with little change in

opening of the pleural cavity on the operating table.

The use of positive pressure has been repeatedly recommended.[2,8] It has been condemned by others,[7] as its effects have been shown to be injurious;[1,7,23,24] increased pressure has been shown to cause (1) rise in venous pressure, (2) fall in blood pressure, (3) decrease in arterial and venous blood flow with lengthening of the circulation time, (4) slowing of respiration, (5) rupture of alveoli or mucous membrane,[25] (6) straining and interference with ventilation and elimination of carbon

dioxide, and (7) retarding of the entrance of blood into the right heart in cardiac patients. While controlled respirations have occasionally been criticized,[8] the distinction between this technic and the use of positive pressure is not always accurately made. Controlled respirations are used routinely by some investigators.[5,16,26] Its advantages are that it provides a smoother anesthesia; often eliminates straining; maintains better oxygenation in all procedures but pneumonectomy, and even here when the breathing is shallow. Its disadvantages are, aside from the danger of raising intra-bronchial pressure, the tendency to spread infected material to normal lung tissue and the occasional inconvenience to the surgeon caused by the movement of the passively expanding lobe or lobes. Increasing the pressure in the airway, whether by the use of positive pressure or controlled respirations, is used to (1) prevent collapse of the sound lung; (2) reinflate collapsed areas; (3) demonstrate lines of demarcation; (4) stabilize the mediastinum; and (5) expand the collapsed lung at the time of closure.

The occurrence of reflexes coincident with surgical manipulation about the hilum is described throughout the literature.[1,6,7,14,18,27] These reflexes, considered due to vagal stimulation, consist of irregular, jerky respirations; sudden periods of apnea; and marked circulatory disturbances, including bradycardia; they often occur at the time of clamping the bronchus. Intravenous atropine injections have been recommended at this time;[27] many workers, however, advocate infiltration of the hilar region or vagus nerve with procaine.[1,14,18] Occasionally, the lower portion of the trachea and the main stem bronchus on the affected side are infiltrated; phrenic nerve block is practiced by some,[4,18] should excessive diaphragmatic movements inconvenience the surgeon.

Finally, the matter of secretions must be dealt with by the anesthetist. The possibility of dissemination of infected material has been considered above. Secretions harrass the anesthetist by (1) par-tially or even completely obstructing the patient's respiratory passages, and (2) bringing about too light and an uneven anesthesia, by the necessity of repeated tracheal aspirations and interruptions of the anesthesia. It is a well known fact that the bronchiectatic patient[16] who exhibits no sputum preoperatively, even after postural drainage, may raise considerable amounts of it when general anesthesia is begun. Preoperative broncho-scopic drainage is advocated by some anesthetists.[10,14] The diseased lobe may be like a sponge and disgorge sputum whenever the surgeon manipulates it.[16]

Determinations of arterial blood oxygen in patients undergoing intrathoracic surgery[28,29] have shown that (1) changes in these levels appear to be independent of the anesthetic agent used; (2) only in the presence of pulmonary suppuration was true hypoxia found, where it was found almost routinely, (3) the duration and type of intrathoracic surgery had no demonstrable effect on arterial blood oxygen levels; and (4) arterial blood oxygenation was normal for good risk patients and low for poor risk patients, regardless of the pathological condition.

The technic employed at the University of Minnesota Hospitals for open chest surgery includes:

1. Rapid induction, often by means of the use of an intravenous soluble barbiturate.

2. Endotracheal intubation, excepting in infants with tracheo-esophageal fistula.

3. The use of the inflatable cuff.

4. Cyclopropane.

5. Carbon dioxide absorption technic (circle type).

6. The use of controlled respirations in selected cases. It has been shown that there is very little blood flow through a collapsed lung, and it is our policy to let the patient breathe spontaneously when the pleura has been opened, as long as all circulatory and respiratory signs remain good. When respirations are controlled, manually exerted pressures of 7 to 10 mm of mercury are used.

7. No constant positive pressure.

8. Lateral, head down position.

9. Frequent re-expansion of sound lobes or lung.

10. For wet-lung cases, frequent tracheal aspirations, at least every ten minutes.

11. Rapid recovery of the cough reflex.

12. The administration of ephedrine, desoxyephedrine, or EA-1 before terminating the anesthesia, to prevent the occurrence of what has been described as "cyclopropane shock."[30]

It has been well said[8] that "during critical periods . . . the anesthetist is easily the busiest man on the team."

The use of large doses of curare to abolish all spontaneous respiratory efforts, coupled with artificial respiration, is one of the very newest developments in modern anesthesia. This method, facilitating the use of controlled respirations throughout the operation, may provide an improved technic for open chest surgery. There is a possibility that the troublesome reflexes referred to earlier may be thus abolished. The straining that often attends repeated tracheal suctioning, which is so often troublesome to the surgeon, may be thus prevented.

The following table is a list of deliberate open chest surgery performed at these hospitals from January 1, 1935, to April 23, 1945. It does not include many cases in which the pleura is often inadvertently opened, as sympathectomy and nephrectomy.

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ORIFICIAL TECHNIC FOR PROCTOLOGIC SURGERY

EXCISION OF ANAL PATHOLOGY IN SITU

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TRUE surgical landmarks that provide reliable guidance to the surgeon are afforded by the discovery that ano-
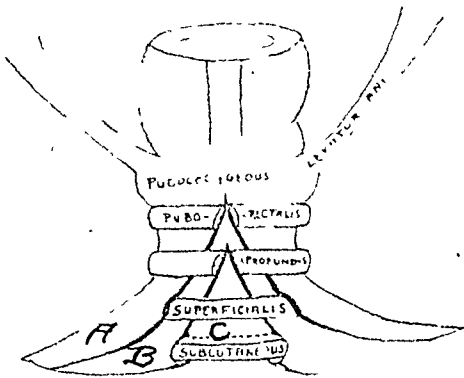
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FIG. 1. Structural scheme of web-like arrangement of anorectal musculature. The inverted v-shaped sections show how sheaths of conjoined longitudinal muscle divide the external sphincter into its components and, thus, form a web. A, B, and C, outer, middle, and inner sheaths, respectively.

rectal musculature is arranged as a web rather than as a series of rings surrounding a tube as has been long supposed.[1-4] These landmarks tell him where, how deep to make his incisions and where not to make them.[5] Abscess, fistula, ulcer, and prolapsing hemorrhoids may be dealt with more accurately by the use of these guiding surgical landmarks. Drainage of all the anal infections is safe and effective when the surgical procedures are guided by the structural landmarks afforded by the "web concept" of the surgical anatomy. (Fig. 1.) However, the problem is only half solved.

These surgical landmarks can be used only when the surgical procedure is applied inside the anal canal. Because these guiding landmarks lose all significance as such

when they are injured or retracted from their normal position, they must be dealt with *in situ*.[6] Therefore, in order to conserve and utilize these landmarks, we should realize that the anal canal is an orifice, and, as such, deserves all of the surgical finesse that is given to other fields of orifical surgery. Because traction trauma is directly proportional to the degree of exposure required by the surgeon, it follows that his interests and those of the patient are best served when those requirements are at the minimum. The purpose of this article is to suggest ways and means to apply the surgical procedures *in situ* so that injury will be minimized and so that the important landmarks afforded by the "web concept" can be used.

The following suggestions have been found to be useful in adapting surgical procedure to a field of restricted exposure (see Figures 2 to 7 showing the use of self-retaining, non-traumatizing, speculum and accessory instruments in orifical surgery): (1) An anal speculum that exposes most advantageously the small degree of tissue space that the orifice affords;[7] (2) accessory instruments (needle-holder, tissue forceps, etc.) whose size and shape conform to the restricted operative field; (3) accessory means of facilitating surgical procedure (such as position of patient, lighting, anesthesia); and (4) the use of a progression of surgical steps in accordance with the anatomic arrangement of the blood supply so that the restricted surgical field will not be obscured by bleeding and instruments.

By way of brief amplification of these points we should realize first that traction trauma not only causes increased postoperative pain and postoperative disability for the patient but defeats the purpose of

the surgeon because it destroys the important guiding landmarks of the canal. The common practice of divulsion of the sphincter, retraction and eversion of the mucous

is ideal and the operative position that the patient assumes on the table is utilized well for this and for the subsequent surgical procedure.
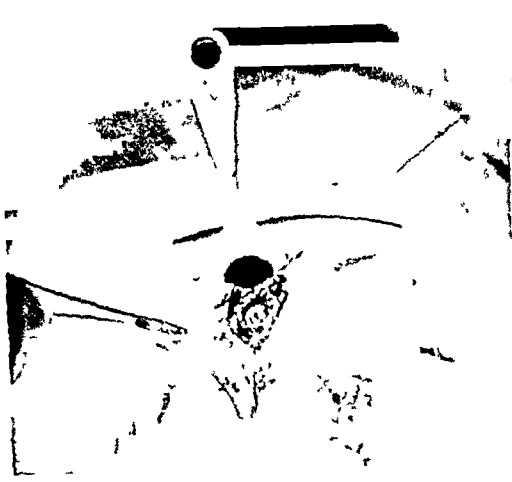
FIG. 2. Sphincter repair. Scar tissue wedge has been excised, sphincter ends freed, and united.

FIG. 3. Infralevator abscess (after excision) originating in posterior crypts.

membrane from the canal, causes a degree of tissue distortion that frustrates all surgical orientation. Rupture of sphincteric muscle fibers, blood vessels, and nerves of the hemorrhoidal plexus results from traction trauma and the ensuing extravasation of blood masks all landmarks. All of this creates such tissue distortion that, as one surgeon says, "The judgement of Solomon scarcely suffices to tell how much tissue to remove and how much to leave." Therefore, all of the principles of orificial surgery are directed toward the purpose of avoiding traction trauma.

We have found that a non-traumatic speculum of a tubular type, affording 180 degrees of exposure is eminently satisfactory. Specially devised accessory instruments (needle-holders, curved scissors, tooth forceps, etc.) are of equal importance. All of the details pertaining to the arrangement of the operating room facilities should be considered carefully. We have found that the prone, semi-inverted position on the table, with the buttocks retracted by means of tapes, and with an overhead light adjusted so that the canal is well visualized are factors of importance. Sacral anesthesia

Finally, a most important factor in this branch of orificial surgery is the actual progression of "surgical steps" in removing the pathological condition from the anal canal. Bleeding, a troublesome feature in

FIG. 4. Anal stenosis with ulcer. A portion of the "subcutaneous ledge" (Fig. 1) must be excised in addition to the ulcer bearing area.

any field of surgery, is an additional handicap in a restricted field of exposure. The presence of instruments in the field further aggravates the obstructions of the surgeon's view. These awkward features can be eliminated largely by adopting a plan

whereby his surgical steps are made in accordance with the anatomic arrangement. Therefore, the first logical step is to direct

established at this "dentate level" in removing anal disorders, hemostasis is obtained by lightly drawing the cut edge

FIG. 5. Exposure of prolapsing hemorrhoids (note prolapsed line of crypts) Patient lies in prone, semi-inverted position with buttocks retracted by adhesive strips.

the surgical approach and to establish hemostasis at the highest level in the canal from which bleeding emanates.[8]

This is the all important "dentate level" (not to be confused with the dentate line of crypts). This is the level where the deep branch of the inferior hemorrhoidal artery enters the submucosal space above the

of the overlying mucosa against the anal wall. Subsequent closure can then be made in a comparatively dry field.

COMMENT AND SUMMARY

By employing the technic of orificial surgery for treatment of anal infections we can use the true guiding landmarks to good
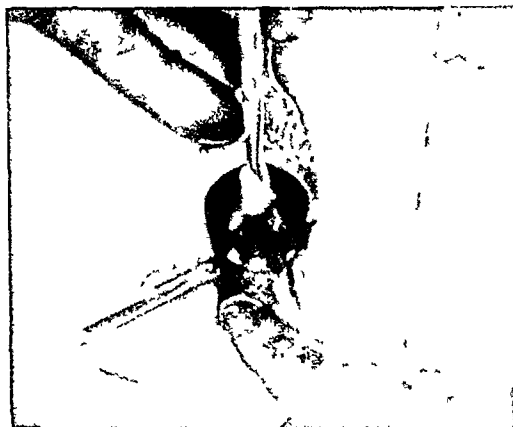
FIG 6 Excision of hemorrhoid in situ. (Fig 7.)

FIG. 7. Closure at "dentate level" after excision of hemorrhoid shown in Figure 6.

profundus division of the external sphincter. This level lies between two easily palpated landmarks: The internal intermuscular groove and the puborectalis muscle which separates the rectal ampulla from the anal canal.

Hence, when the line of excision is

advantage, remove pathological conditions effectively, and avoid the evils of traction trauma which not only jeopardizes the welfare of the patient from the standpoint of postoperative pain and disability but defeats the efforts of the surgeon by destroying landmarks.

Here, then, is both an opportunity and an obligation for the proctologist: Because the clarified surgical anatomy of the anorectum obliges him to adapt his technic to the part, the degree of skill that he attains in doing this will enhance the significance of his speciality accordingly.

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THE imperforate anus is readily corrected by an anteroposterior midline incision over the anal depression, or over its usual location if no proctodeum is evident. The rectal pouch is identified, grasped with hemostats, opened by an anteroposterior incision, and sutured marginally to the skin with black silk sutures. The mucosa is not included in these sutures, to prevent eversion and prolapse in later life. Insertion of a rectal tube completes the operation.

From "Ambulatory Proctology" by Alfred J. Cantor (Paul B. Hoeber, Inc.).

ANESTHESIA IN AN EVACUATION HOSPITAL

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THIS article is a report on 7,500 consecutive surgical cases in an Evacuation Hospital in the E.T.O. Of these, 6,872 patients required some form of anesthesia beyond sedation. I have purposely labelled it as a report because I have no axe to grind. It is hoped only that by setting down some of the observations on such a number of cases, we may learn something worthwhile. I sincerely hope that more reports of this nature will be made to afford comparison with our own work.

Anesthesia in a busy Evacuation Hospital can properly be described as a nightmare when compared to that in civilian or fixed Army institutions. Many factors are responsible for this condition. The desperate cases in large numbers are a tremendous responsibility. Add to this the necessary rush—twenty-four hours a day—with inadequate, insufficient help and the physical disadvantages of working in hurriedly erected tents and the condition is self-explanatory. It is impossible to describe the utter difference from anesthesia in any other type of place.

Our hospital was a 400-bed Evacuation Hospital. Most of the time we had several auxiliary teams added to our own staff. Some of these teams had their own anesthetist and some depended on us for help. There were two medical officers and four nurses on our regular anesthesia staff. As we worked on a twelve-hour shift, that allowed one officer and two nurses for each shift. In our opinion this was a minimum and more of our personnel should have been trained in anesthesia. Due to a shortage of Field Hospitals, our work included an increased number of chest and abdominal cases. Unquestionably, this circumstance modified our anesthesia.

I am convinced that the anesthetist's job begins in the preoperative and shock wards. Teamwork is highly essential; and it is only fair to the patient and anesthetist to give the latter a chance to study and advise from the time the patient is admitted. From his experience with patients on the operating table the anesthetist is the best judge of the optimum time for operation in serious cases. I believe that too much time is spent in preoperative wards in many of these severe cases. A trial period of not more than two hours maximum should be given. If the patient does not show any response, the chance of immediate operation must be taken. Patients who are so badly injured that they will not respond in two hours will not improve with more time but will actually slip backward. If a patient does show some response during the initial two hours of shock treatment, he becomes a problem of constant watching and should be operated upon when sufficiently recovered or when he fails to continue to improve. Too often the mistake is made (and we made it ourselves many times) of procrastinating in the blind hope that somehow a patient will improve if given more time. For emphasis, I should like to repeat that a trial period should be limited to two hours at the most in any case, regardless of the nature of the injury.

The question of using a tourniquet on badly injured extremities is a delicate one. For some reason the idea of placing a tourniquet on a limb as a measure to control shock is abhorrent to some for various reasons. However, the theory is sound. I an aware of the so-called dangers such as embolism. But it seems as likely that embolism can occur from the badly traumatized flesh and bone. We had several cases in which an extremity was so badly damaged that the surgeons agreed that it

must come off after shock was controlled. In some of these we placed a good tight tourniquet just above the level of future amputation and proceeded with shock treatment. Our experience was limited, but we believed that the response in these cases was much better than in similar ones where a tourniquet was not used. The discomfort was not great. In shock patients who were properly sedated, there was no real problem on this score. The idea of combining refrigeration with a tourniquet comes to mind. Unfortunately, we did not have an opportunity to try cold therapy. But an interesting observation may well be added here. This is, that men who were not picked up promptly after being wounded, due to battle conditions, often seemed in better shape and their shattered limbs responded better for having been exposed to cold temperatures for several hours.

Premedication was a very routine procedure. Intravenous morphine plus atropine or scopolomine in the operating room was standard. We encouraged the preoperative and shock sections to administer sedatives intravenously only, and then only when necessary. We had no difficulty with the intravenous route. Our only difficulty came from large or repeated doses of morphine given subcutaneously or intramuscularly elsewhere and not absorbed until the shock had been overcome. There were too many cases of severe respiratory depression from earlier morphine administration, occasionally as long as six to eight hours previously when no sedative was given at our hospital. Clearly then, these were cases of delayed absorption.

Many factors entered into our choice of an anesthetic agent for an individual case. Did the patient have a cold, or was he a victim of a hidden blast injury to the chest; was he a potential shock case; did he have massive soft tissue injury; was the surgeon a slow or fast worker; was the anesthetist well trained or not; what was the most time saving anesthetic (provided two or more were equally good in that particular case); and finally what complications might be

expected? I can say only that our aim was to choose the agent which seemed best for the patient. There is no doubt that we made errors. But in general we leaned toward safety above all else. At times we incurred the displeasure of an impatient surgeon by electing to use ether instead of pentothol sodium. But we were fortunate for the most part in our relations with the surgeons, and our chief of surgery ruled that the anesthetists were to decide the type of anesthesia. We were also charged with the responsibility of deciding when an operation should be terminated if a patient became bad, as well as complete supervision of shock treatment during and immediately after surgery. This may sound rudimentary, but it was surprising to find that in many instances people who could do a venipuncture and hold a jaw or pour ether on a mask were looked upon as anesthetists.

Statistics are unreliable, but some index of the type and quantity of various anesthetic agents can be gained from the following figures (Table 1):

TABLE 1

	First Series Before Regional Total Cases— 3524 Anesthetics— 3232		Second Series After Regional Total Cases— 3976 Anesthetics— 3638		Third Series All Cases Total Cases— 7500 Anesthetics— 6870	
	No.	Per Cent Anesthesia	No.	Per Cent	No.	Per Cent
Pentothol sodium	2061	63.7	423	11.7	2484	36.1
Ether	463	14.3	542	15.0	1005	14.6
Spinal	70	2.1	199	5.5	269	3.9
Nitrous oxide	24	.8	62	1.8	87	1.4
Local	554	17.2	1071	29.7	1625	23.6
Block	60	1.8	1341	36.3	1402	20.4

These figures are a simple breakdown of 7,500 consecutive surgical cases with a

total of 6,872 anesthesias of various types. I should like to mention several points to avoid confusion. In a considerable number of cases more than one agent was used. In the figures above the more potent agent was used. In the total of 7,500 cases, 628 were given no anesthetic. The figures are divided into two series chronologically and because of a change in technic. The first series covers a period up until we started using regional anesthesia on a large scale. The second series runs from that point to the end of the 7,500 cases.

REGIONAL ANESTHESIA

In November, 1944, we were fortunate to have a well trained instructor in regional anesthesia stay with us for a time. He taught us how to do many types of block anesthesia in a simple manner. A large proportion of battle casualties are in the extremities and a glance at the figures shows how many are suitable for block anesthesia. At the time, we were running into a large number of upper respiratory infections, blast injuries of the chest, and postoperative pulmonary complications. Suffice it to say here that the technic was easily learned, postoperative complications were markedly reduced, the patients began to eat and drink immediately, they cooperated on the operating table, and the percentage of failures was very small. We were, and are still, very enthusiastic about this type of anesthesia.

PENTOTHOL SODIUM

It is interesting to notice from the figures how the percentage of pentothol anesthesia fell off in the second series. It is a very useful agent but has several drawbacks. It is too easily administered. Consequently, inexperienced people were assigned to give anesthetics; and pentothol was being used in questionable cases such as hidden blast injury to the lungs, anemia from hemorrhage, and upper respiratory infections of undetermined extent as well as in potential shock cases. It was easy to fall into the error of using an agent which was rapid, without sufficient thought about the complications. Laryngospasm was an annoying and potentially dangerous complication in too many cases. This was partly due to the turning and rolling of patients to get at multiple wounds. Postoperative pulmonary complications occurred fairly often, especially in the colder months. Due to the rapidity of "turning out" cases and the exhaustion of the soldiers from combat we ran into long narcoses following pentothol. My conclusions about pentothol are that it was a good agent if used properly, but that it was dangerous in the sense of being used too much in questionable cases and often by untrained help.

ETHER

We used this old standby in what may seem to be a high percentage of cases. Nevertheless, we believed we were justified in this on the basis of safety. We found that ether in the hands of even an unskilled individual was relatively safe. Almost all patients improved during induction. Also, we had a rather high percentage of chest and abdominal cases as well as maxillofacial. Although ether was a slower procedure, we were of the opinion that in these instances our choice was sound.

SPINAL

At first we used this agent sparingly and only in elective cases. The sights and sounds in a busy Evacuation Hospital surgery added to the already strained nerves of combat troops were not conducive to a smooth spinal anesthetic. But as we became more familiar with various types of mental conditions and more accustomed to the surgeons, we decided to use low spinal in more and more cases. By a low spinal I mean a small dose of procaine —average 75 mg.—in lumbar 3 to 4 with 2 cc. of diluent and no barbotage. There was very little change in blood pressure and the procedure was simple. A further advantage was that one anesthetist could do several of these in a short time and thereby keep many surgeons busy. This was helpful

especially when we were short of help in anesthesia. We were careful to eliminate potential shock cases as much as possible and to use spinal only in moderate wounds without massive tissue destruction. There were no serious complications and failures were almost unknown.

NITROUS OXIDE

Except for ether induction we did not use this agent extensively. Perhaps it should have been used more. But our feeling was that it was not worth the effort. Whenever nitrous oxide could have been used, we were able to employ either pentothol or regional and they seemed to work better in our hands. Many soldiers became excited under gas anesthesia and often they vomited at an inconvenient time.

LOCAL

There is little to be said about this type of anesthesia which is not already known. We avoided injecting the material into infected areas. But it was used a great deal for minor surgery and chest and maxillofacial cases.

COMPLICATIONS DURING ANESTHESIA

Shock and Hemorrhage. This was our biggest problem and is too extensive a subject to cover here. We relied primarily on intravenous fluids; the type depending on the individual patient. We never hesitated to use the rapid injection method of pumping fluid into the veins. By attaching a blood pressure bulb to the airway and using multiple veins—sometimes both arms and both legs—simultaneously, tremendous quantities of fluid can be administered in a short time. For example, we pumped eight litres of blood and plasma into one patient with intraperitoneal hemorrhage in less than ninety minutes and the desperate patient survived. This illustrates the principle that drastic wounds require heroic shock treatment. We learned to have little faith in stimulant drugs, except as a very temporary lift to tide a patient over a

crisis. It is dangerous to attempt to carry a patient on injections of adrenalin or nikethamide alone. Shortly that patient will go into an irreversible shock. It is worth noting that the slow administration of stimulants is far superior to the rapid. In our hands, an ampule of ephedrine mixed in a bottle of plasma or inserted high into the tubing just below the flask gave far better results than any other drug or any other method of rapid or divided-dose administration.

Laryngospasm. This occurred fairly frequently, especially with pentothol and when patients were rolled around to get at multiple wounds, in spite of the rigid rule of atropine or scopolomine before all general anesthetics. A few cases required intubation after cocainization. But most of them responded to more atropine (or scopolomine), oxygen and artificial respiration. We never performed an emergency tracheotomy under anesthesia. However, there were three cases of face and neck wounds in whom a tracheotomy was performed under local before anesthesia was started. An elective tracheotomy is a far simpler and wiser procedure than one done as an emergency in the middle of an operation.

Respiratory dysfunction whether due to spasm, obstruction, depression or blast injury was quite common. If it could not be corrected immediately, strong measures were used because it was our belief that hypoxemia was a serious sign, especially in patients who had lost considerable blood. One of our rules was that a patient under pentothol was immediately switched to ether if this condition occurred and could not be overcome quickly. We never hesitated to make this switch from pentothol to ether if, for any reason, the patient was not doing well. I feel very strongly that we avoided some serious consequences by this practice.

Vascular Accidents. There were no proved cases of embolism occurring during anesthesia. With such massive destruction of tissue and bone, emboli would seem to

be a frequent possibility. We observed at least a dozen cases of what we thought might have been cerebral spasm or embolism. Each case showed a rather constant set of clinical signs. The syndrome, if it may be called that, always occurred during· débridement of soft tissue or manipulation of fractured bones with one exception—an appendectomy for an early mild appendicitis. Typically, it came on after the induction stage and when the patient was being easily maintained. There was a sudden respiratory change to shallow, jerky breathing; the color became less pink but not cyanotic; the pulse increased 15 to 30 beats per minute and became less full. In the few cases in which it was possible to record blood pressure, it remained fairly constant or increased slightly; and the most striking change was a sudden wide dilatation of one pupil only. This condition was not affected by anything that we did and we tried many things. Its duration varied from five minutes to nearly two hours with a gradual return to normal. None of the cases resulted in any serious consequence. In one, under ether anesthesia, the operation was continued for nearly an hour without further anesthesia. This patient reacted a little slowly but otherwise normally except for the dilated pupil which did not return to normal for twelve hours. To my personal knowledge one case occurred under spinal, three under pentothol and two under ether anesthesia.

Vomiting. This complication did not trouble us very often. Most of the wounded men had had little in the way of liquids for several hours and apparently the fluids are responsible for most vomiting because many of the men had food in their stomachs at the time of operation. Of course Army food at the front was mostly canned and of the concentrated type. This may have had a bearing on the situation also. It is worthwhile to note here that severe injuries delay the emptying of the stomach. We had cases who vomited food, which seemed to be completely undigested, twelve to eighteen hours after ingestion.

Intubation. We practised this very frequently and felt justified in doing so. With rapid work, inexperienced help, frequent lung injuries and not infrequent respiratory· depression from accumulated morphine or head injury or anoxemia, intubation proved to be a wonderful safeguard. There were no serious results from its use. We always applied cocaine 10 per cent to the vocal cords before inserting the tube and in cases, such as maxillofacial or throat, where the tube was retained for twenty-four hours or more a few drops of cocaine were put into the tube often enough to quiet the patient. We also intubated and applied suction in every case of vomiting or aspiration and were frequently amazed at the amount of material recovered from the bronchial tubes.

POSTOPERATIVE COMPLICATIONS

To discuss most of these would be out of reason in a paper such as this. But a few points will be mentioned. Oxygen was used very liberally and in all cases which presented head or chest injury, shock or respiratory depression. I believe that oxygen should be used more in civilian practice postoperatively. Too often a serious case is carried through an operation successfully only to go bad in a recovery room (sometimes irretrievably) due to an oxygen want and the extra burden that this puts on the heart and tissues.

Oxygen under pressure was used very successfully to combat pulmonary edema. It can be administered very simply without any special apparatus. We did this by removing the rubber sponge diaphragm from one side of the B.L.B. mask and putting a cork in its place. Through this cork a piece of glass tubing was inserted and a rubber tube led from this to a bottle of water with 5 or 10 cm. of water in it. When the mask was strapped tight to the face and the oxygen turned on sufficiently, the patient received oxygen under a pressure of approximately the number of cm. of water in the bottle. With atropine, oxygen

under pressure was our best treatment for pulmonary edema.

A curious type of pulmonary edema was noted enough times to rule out coincidence. This occurred when patients, not necessarily severely wounded, were given blood at our hospital several hours after administration of plasma at a forward station. The total volume of neither fluid affected the incidence of pulmonary edema. There were cases in which this condition developed after having only one unit of plasma (250 cc.) at an advance station and only part of a unit of blood (500 cc. blood) at our hospital. Some of these patients were not really in shock either. Because the edema developed in cases such as these in which the total fluid given was small, and because edema did not develop in some cases in which large amounts of fluid were given sometimes rapidly, I should like to suggest the possibility of an anaphylactoid type of reaction being at least partly responsible.

Deaths. Anesthetic deaths are a difficult subject, because it is only by ruling out every other possibility that we can place the blame on the anesthetic agent. The question is even more involved when we are dealing with men who have been subjected to severe physical violence. For example, one of our early deaths was a neurological case who died just after induction with pentothal and before the surgeon started to work. Autopsy showed that the man died of a sudden hemorrhage into the upper spinal cord near the site of injury. Was the pentothol responsible for the hemorrhage or would he have had it anyway? Could this be called a truly anesthetic death? I believe not. Another death occurred during pentothal anesthesia for a penetrating wound of the frontal lobe of the brain. The patient had been given the anesthesia and carried for over one-half hour without difficulty, when he suddenly

expired of a combined respiratory and circulatory failure which was not affected by stimulants. The surgeon had been starting to suck away the damaged brain when the accident happened. But we had several cases of unexplained sudden death in our neurological cases. Some of these occurred under ether and some under local. In the case above it was difficult to determine the rôle of the anesthetic agent, but we listed it as an anesthetic death. Another case which puzzled us was a not too severe maxillofacial wound. This patient was given ether and intubated, all without incident. After an hour, the anesthetist stopped the ether and was carrying the patient on oxygen plus what ether was in the tubing when he suddenly turned cyanotic and stayed that way under pure oxygen and artificial respiration. After five minutes of this the patient expired. Autopsy showed nothing but an early small pneumonia of one lobe. My personal opinion was in favor of a cerebral accident in spite of the autopsy and not an anesthetic death.

There were several other cases in which the anesthetic might have caused death or been partially responsible. But we were never able to prove conclusively in any case that the death was due solely to the anesthetic; and there was no indication in our series of cases that one agent was more responsible for deaths during anesthesia than any of the other agents.

SUMMARY

A report on anesthesia in an Evacuation Hospital in the E.T.O. has been given. It was based on observations on 7,500 consecutive surgical cases requiring 6,872 anesthetics. The report was informal but contained two series of figures to show the change from a preponderance of pentothol to that of regional anesthesia.

EARLY WALKING AFTER MAJOR GYNECOLOGIC SURGERY

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SURGICAL advances have gone hand in hand with advanced knowledge of physiology. In surgery, and in every surgical subdivision, new procedures and therapeutic aids have been eagerly grasped and put to careful test and trial. In a great part, this physiological approach in modern surgery has been responsible for spectacular strides in the past several decades. Despite this, we have been loathe, or even failed to recognize that a cardinal physiologic principle of postoperative care is being constantly violated. Prolonged bed rest after operation is unphysiologic and leads to numerous preventable complications and even deaths. The tradition of long bed confinement handed down from the time of Billroth, as absolutely essential to good wound healing, has persisted and has gone relatively unchallanged until fairly recently.

The subject of early walking is not new to European surgery. In this country it had a most favorable report in 1941 when Leithauser and Bergo[1] reported a study of 484 cases of early postoperative walking. Two years later Leithauser[2] followed this with a further report concerning 900 cases. Newburger[3] gave a comprehensive survey of the world literature relative to postoperative ambulation.

It is the purpose of this paper partially to review the work of others and to present a series of 132 cases of early ambulation after major gynecologic opeiations and their results. A number of cases of appendectomy are included because, in many instances, gynecologists are called upon to perform this operation.

EARLY WALKING

Various authors speak of "early walking" according to their own interpretation. Mermingas[4] insisted upon patients who had been operated on under local anesthesia, walking immediately from the operating room to their beds. Others[5,6,7] allowed their patients to become active on the second or third day. The latter is scarcely early ambulation in the true sense, as will be shown later in this paper.

TABLE I

ANALYSIS OF PATIENTS (132) WALKING WITHIN TWENTY-FOUR HOURS AFTER MAJOR GYNECOLOGIC SURGERY

Type of Operation	No of Cases	Average Age	Highest Temp	Length of Hospital Stay, Days	Complications
Operations on uterus (hysterectomy, hysterotomy, myomectomy)	28	33 9	101 0°	11 1	1 pneumonia 1 phlebitis 1 infected wound
Operations on adnexa	23	30 1	100 6°	9 4	1 mild ileus (Wangensteen)
Operations on uterus and adnexa	23	36 9	100 8°	11 3	2 mild ileus (Wangensteen) 1 phlebitis
Vaginal plastics (cystorectocele repair)	14	42 4	99 8°	11 8	None
Fothergill, LeFort, etc	4	54 3	100 7°	12 8	None
Vaginal plastics, plus operations on uterus and/or adnexa	8	33 8	100 9°	11 5	None
Appendectomy	32	22 3	100 1°	6 4	1 atelectasis
Total operations	132				

This report concerns patients who have been allowed up within the first twenty-four hour period postoperatively. Before operation the patient is informed assuringly that she will walk with help the day after operation, and that the objective is to avoid complications, to gain strength, and to be able to return home sooner than would be otherwise possible. Surprisingly, little resistance is offered, and the stubborn woman can be easily persuaded if it is made known that early ambulation will be of great benefit to her in the period of con-

valesence. When an abdominal incision has been used, a firm binder is applied to the abdomen and with the aid of a nurse or orderly, the patient walks about the bed two or three times daily. Deep inspirations and frequent coughs are encouraged. With an increase in the patient's confidence and strength, this amount of exercise is subsequently increased. When a vaginal procedure has been done, it is not necessary to use additional protections or added binders.

PATHOLOGIC AND PHYSIOLOGIC CONSIDERATIONS

Thrombosis and Embolism. These sequelae always have been the sword hanging over the head of the surgeon. Miller[8] states, "thrombosis and embolism are far more frequent after hysterectomy than after any other operation." In a survey of all services of the Mt. Sinai Hospital, Neuhof and Klein[9] report eighty-eight cases of fatal pulmonary embolism proven by necropsy, and of these, nine were following gynecologic operations. Others[10,11] record the instance of venous thrombosis and pulmonary embolism of 1 per cent of all operative procedures, 2 per cent of laparotomies and 3 per cent of all laparotomies performed in female patients.

It has become increasingly apparent that long confinement to bed, whether the patient was postoperative or not, was a factor in the retardation in the blood flow and a contributing factor in thrombosis of the deep veins of the lower extremities. A growing interest in the subject of thrombosis and embolism has become apparent in the literature of the past few years when we see entire or almost entire issues of journals devoted to this subject. The editors of *Surgery*[12] deemed it of such importance that almost a whole issue was given to a symposium on the subject of thrombo-embolism. Similarly, the *Journal of the American Medical Association*[13] recently saw fit to publish in one issue six articles on the subject of "the abuse of rest." Sporadically, but more and more

often, there are articles by authors in various fields of medicine testifying to their belief that many deaths are unnecessary and avoidable.[14,15,16,17] These publications are important in overcoming the inertia of tradition.

Frykholm[18] notes that the areas of thrombus formation in patients confined to bed after operation are: (1) the plantar veins, (2) the muscle veins of the calves, (3) branches of the deep femoral veins, and (4) the pelvic visceral veins. He believes that when a patient is confined to bed, the veins of these areas are, to a certain degree collapsed, or pressed together so that two intimal layers are in close contact. DeTakats[19] is of the opinion that after major operations a subclinical shock state develops, accompanied by hemoconcentration. With hemoconcentration, there is resultant increased blood viscosity which contributes to a slowing of the venous blood flow as well as an increasing tendency toward intravascular clotting. This hemoconcentration is often augmented due to the nausea and vomiting with decreased fluid intake after operation. That there is a high clotting index is proven by the work of Bancroft, Stanley-Brown and Quick,[20] who found this increase existed in 12 per cent of all surgical patients. Smith and Allen[21] believe that early exercise prevents venous pooling. Speaking from pathologic observation concerning the effects of bed confinement, Dock, of the New York Hospital, states,[22] "more vividly than others, the pathologist is aware of the cost in lives of this form of therapy. In the last 300 autopsies on adults in this hospital fifteen, or 5 per cent died of pulmonary embolism, secondary to thrombosis in the legs or pelvis. At the San Fransisco Hospital, Westdahl demonstrated such pulmonary emboli in 13 per cent of the autopsies and in 3.5 per cent they were the immediate cause of death. At the New York Hospital about as many people die of massive pulmonary embolism as of carcinoma of the stomach or of bacterial endocarditis. These deaths are undoubtedly

due to a therapeutic measure—complete bed rest. Other deaths probably equal these dramatic ones in number following bed rest as an indirect sequelae—bronchopneumonia being the most common."

In the present series of 132 gynecologic cases no fatal pulmonary embolism occurred. There were two instances of phlebothrombosis. In one of these cases. there was no known history of previous thrombophlebitis. Despite early walking, an attack of thrombophlebitis of the right leg occurred and with dicumarol therapy proved of no serious consequence. This case is mentioned below:

Mrs. L. F., a forty-year old housewife, was admitted to the hospital on November 7, 1944. She had been under observation for two years because of persistent right lower quadrant pain and low backache. The menstrual history was not remarkable. The past history disclosed an operation elsewhere for salpingitis in 1928 with wound rupture. She had been under medical treatment for a peptic ulcer since June, 1943. Examination of the abdomen revealed a midline scar with evidence of drainage at the lowermost portion of the incision. Pelvic examination disclosed a soft mass the size of a football lying chiefly in the right half of the pelvis and abdomen and reaching to within a few fingerbreadths of the costal margin. In places this mass was cystic to the touch. A diagnosis of multiple fibroids was made.

Laboratory studies were as follows: red blood cells 4,140,000, white blood cells 5,400, hemoglobin, 6 Gm., sedimentation rate, 2 mm., Kline diagnostic and exclusion test negative. The patient was given 500 cc. of blood pre- and postoperatively. On November 8, 1944, a large soft fibroid was removed together with a cystic right ovary three times the normal size, and a chronically inflamed tube. The left tube and ovary had been removed at a previous operation. Pathologic diagnosis: Intramural fibromyoma; corpus luteum, follicular cyst of ovary; focal acute salpingitis.

On November 9th (the first postoperative day) the patient walked with assistance about the bed twice. On the following day there was a cough with slight chill. Breath sounds and voice fremitus were absent at the right base and there were a few râles at the left base. The patient was placed on sulfadiazine therapy. Bed-side plate of the chest was negative for pulmonary disorder. On November 16th she developed pain in the calf of the right leg. Her temperature was 99°F., pulse, 86. There was a positive Homan's sign. Dicumarol 300 mg. was begun immediately and for the next few days the temperature remained at 99°F. However, the pulse rate was 100 for two consecutive days, and then gradually fell. The dicumarol was continued until November 26th with the prothrombin concentration being kept between 22 per cent and 32 per cent of normal. The twentieth day postoperatively she was discharged.

One patient developed phlebothrombosis who had a known past history of a similar attack.

Mrs. E. B., a thirty-six-year old patient, was admitted to the hospital on March 10, 1945, complaining of dysmenorrhea and menorrhagia. These symptoms had been present for seven years and had become progressively worse. There was a generalized pelvic and abdominal pain for the past several months prior to admission, worse in the right lower quadrant. She had two children. A history of acute phlebitis following her last pregnancy with hospitalization for six weeks was disclosed. Two years ago following a fall she had developed an ulcer of the leg which necessitated a high saphenous ligation and skin graft. Pelvic examination revealed a marital introitus. The cervix was clean. The uterus was enlarged to three times the normal size with a very tender mass in the left adnexal region. A diagnosis of uterine fibroid with possible chronic adnexitis was made.

Laboratory findings revealed red blood cells 4,300,000, hemoglobin 13.75 Gm., sedimentation rate, 15 mm., Kline diagnostic and exclusion test negative. The urine was negative except for an occasional pus cell.

At operation on March 12th, multiple fibroids were removed and an incidental appendectomy performed. Because of the definite history of phlebitis, anti-coagulant therapy was begun on March 13th (first day postoperatively), and 300 mg. of dicumarol were administered, and then withheld for the following twenty-four hours because of a prothrombin concentration of 19 per cent of

normal. On March 15th (third day postoperatively) despite early walking and dicumarol, a positive Homan sign was elicited. There was no change in temperature of the extremity as compared with the left. The arterial circulation was good. On March 16th 200 mg. dicumarol was given. On March 17th the prothrombin time of 50 seconds, or a concentration of 8 per cent of normal was obtained. The patient had a moderate amount of bleeding per vagina and all anti-coagulant therapy was stopped. On March 22nd she complained of moderate pain in the right calf after being up and walking. The pulse and temperature were normal. The subsequent course was uneventful. She was discharged on the twelfth day postoperatively.

This case is reported not to discuss primarily a thrombo-embolic sequel to operation, but to illustrate that all patients about to undergo pelvic surgery require careful inquiry as to past history of phlebitis. If ambulation and anti-coagulant therapy are begun soon after operation, deaths may be averted.

Pulmonary Complications. That pneumonia secondary to pelvic and abdominal operations is a common occurrence is a well known fact. Pulmonary atelectasis, collapse of the lung and bronchitis are likewise fairly common. The figures mentioned by various authors are of some interest. Cutler,[23] in 1941, found that 4.5 per cent of all surgical patients developed pulmonary complications. Others[23,24,25] believe that 10 to 20 per cent of all patients subjected to abdominal operations will develop pulmonary sequelae. Coryllos[26] believes that a much higher percentage of minor pulmonary complications develops after operation.

After operation there are numerous changes in respiratory physiology: (1) reduction of diaphragmatic movement with splinting of the thoracic and abdominal muscles; (2) inhibition of cough reflex; (3) bronchoconstriction, and (4) excessive mucous secretion. These are often coupled with hypostatic congestion and pulmonary collapse.

The recumbent position after operation tends to initiate, increase and aggravate these factors. Early ambulation (within twenty-four hours) is necessary, if it is to be used at all, for it has been demonstrated that 50 per cent of pulmonary complications develop within the first twenty-four hours, 75 per cent by the end of forty-eight hours and 90 per cent by the end of the fourth day.[3,23] Leithauser[2] measured the vital capacity before and after operation in patients using early walking, and found that the vital capacity returned to normal in two to seven days as compared to seven to 14 days in patients confined to bed. Mermingas[1] found but thirteen minor pulmonary complications in 527 patients allowed to walk early after operation. There were no respiratory deaths. Leithauser[2] records only two pulmonary complications in 900 cases in his own series. In a review of the literature he found four pulmonary embolic deaths in 15,000 cases using early postoperative rising. In the group of cases reported here only one proven case of postoperative pneumonia occurred. There was one instance of minor atelectasis which readily responded to treatment.

While early ambulation is not the entire answer to the problem of postoperative pulmonary complications it is certainly most encouraging to the clinician to know that untoward results and pulmonary morbidity can be held to a minimum.

Gastro-enteric Complications and Disturbances. While it is difficult to report accurately the number of cases of gastro-enteric upsets in any given group of post-operative patients, the author was notably impressed by the few instances in which Wangensteen suction was required in this series. Newburger,[3] Joseph,[27] and Boldt[28] believe that early walking reduces the degree of postoperative gastro-enteric atony, combats acute gastric dilatation and wards off generalized intestinal distention.

Experimentally little investigative work has been done along these lines. Clinically, however, the vast majority of patients employing early ambulation offer sufficient

proof that this method is effective in combatting postoperative ileus.

Genito-urinary Complications and Disturbances. Urinary retention after gynecologic and abdominal operations is frequent and often troublesome, leading in many instances to repeated catheterizations and resultant cystitis. McLaughlin[29] carried out careful studies in 1,964 male surgical patients with significant results, using no specific measures to prevent urinary complications. One group was allowed up at the bed-side postoperatively to use the urinal as compared to a group kept confined to bed. There was only a 0.29 per cent incidence of urinary retention as compared to a 21.9 per cent incidence occurring in bed-fast patients.

Because of the considerable number of cystocele repairs in the series of cases presented here it would be unfair to include this group; therefore, figures referable to catheterizations were not tabulated. However, the impression gained that catheterization and cystitis are decreased is definitely in accord with the reported findings of Newburger,[3] Mermingas,[4] Leithauser,[2] and Rickles.[30]

Effects of Early Ambulation on Wound Healing. Newburger[31] from experimental work and clinical experience concluded that the lag in wound healing was decreased with early ambulation. Leithauser[1,2] attributes this shortened lag period to increased blood supply, improved lymphatic drainage and decrease of disuse atrophy of the repaired parts. Patricelli[32] believes that the greatest danger of evisceration is on the sixth to eighth day and that the surgeon following conventional rules will allow the patient some activity at that time. No case of wound disruption or evisceration occurred in the series here presented. This is in keeping with the reports of other writers on the subject.

Suture Material. The type of suture material used varies with the individual surgeon, and in my opinion, is not of prime importance. In this series of cases No. 000 chromic catgut was used, with fine silk to the skin, in every operation for appendicitis. In pelvic laparotomies and vaginal plastic operations sutures exceeding No. 1 chromic catgut were never employed. Stress is placed on absolute hemostasis and careful approximation of wound layers. In the suturing of the rectus fascia interrupted or mattress sutures of No. 1 chromic catgut were used. The paramedian and Pfannenstiel incisions were employed in the majority of cases.

The type of anesthesia used was inhalation with cyclopropane.

Duration of Hospital Stay. Numerous operators report a decreased stay in the hospital using ambulation. The average length of time for all surgical patients treated by conventional methods has been estimated at eight to twenty-one days.[32,33] Leithauser[2] has been able to discharge simple appendectomy cases on the average of 2.5 days after operation, and the average length of hospital stay in 900 surgical patients was 4.0 days. Vickers[34] employing early ambulation could discharge his patients from the hospital by the fifth postoperative day. Rickles[30] allowed most of his patients home by the third postoperative day.

In the series of patients reported here, no studied attempt was made to discharge patients very early for two reasons: First, early ambulation was a new therapeutic aid in this locality, and to overcome certain prejudices a compromise time of discharge was set. Second, the majority of patients carried some form of hospitalization insurance and were averse to leaving the hospital early. With certain individuals and those without insurance greater cooperation was secured. The average patient undergoing appendectomy in the group was discharged after 6.4 days, while the woman who had undergone pelvic laparotomy was sent home from the ninth to the eleventh day. In many instances it was possible to discharge patients after appendectomy on the fourth postoperative day, and patients after pelvic operations as early as the sixth day after operation. Col-

lected figures prove that hospital stay can be cut in half.

In these days when hospitals throughout the country are crowded, and when a large segment of our people are in dire economic straits, a shortened hospital stay per patient is of considerable importance.

CONCLUSIONS

Prolonged bed rest for the surgical patient is unphysiologic and is the continuation of the traditional therapy carried over from the late nineteenth and early twentieth centuries. It is contributary to unnecessary pulmonary and circulatory deaths, to gastro-enteric and genito-urinary complications. Early ambulation helps prevent these complications, decreases mortality and morbidity.

The morale of the patient is greatly improved since there is the feeling that with the return to more normal activity the dangers of the operation and complications of the postoperative period are over, and that they have been widely exaggerated by their friends and relatives.

Last, but not least, the economic value of a shortened hospital stay is a consideration to the patient and an aid to the overcrowded institution.

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LUMBAR SYMPATHECTOMY FOR CHRONIC LEG ULCERS[*]

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CHRONIC ulceration of the lower extremities may be associated with vasospasm, either because the patient has always had increased peripheral sympathetic activity or because of increased activity secondary to the local lesion.[1] This is especially true of ulcers of the lower third of the leg following deep thrombophlebitis, varicose veins, or recurrent bouts of cellulitis with subsequent fibrosis. If the circulation can be increased, the extremity is less apt to develop excoriations, and fungus or other infections may be better controlled. In addition passive vascular exercises may be employed more effectively. The nerve path to the lower extremity for vasomotor and sudomotor impulses is the same. Both are carried over the sympathetic nerves arising from the last thoracic to the second lumbar spinal nerves. With hyperactivity of the sympathetic nervous system there is greater constriction of the vessels and more sweating occurs which further lowers the temperature of the skin. Whether this phenomenon of sweating is entirely due to sudomotor hyperactivity or to increased capillary permeability remains unanswered.

When chronic leg ulcers fail to respond to ordinary methods of treatment we have found that lumbar sympathectomy is of definite value. The diagnostic test utilized as an indication for operation is satisfactory response to paravertebral procain infiltration of the first to fourth lumbar ganglia. This response is indicated by warm and dry skin, relief of pain and increased arterial pulsations.

In performing lumbar sympathectomy we employ the procedure as advocated by Flothow and Swift.[2] A transverse incision is made on the anterior abdominal wall about one inch above the umbilicus, the obliques and transversalis muscles are split in the direction of their fibers and the sympathetic chain is approached extraperitoneally. Spinal anesthesia is preferred. When the sympathetic ganglia are to be removed from both sides, the second operation is performed one week after the first. By placing silver clips as markers of the extent of the upper and lower extremes of the excision of the sympathetic trunk, and following with postoperative x-ray studies, it was found that the clips usually extended from the level of the second lumbar to the superior portion of the fourth lumbar vertebral body. Usually only the second and third ganglia are removed, since the first lumbar ganglion is in the region of the diaphragm, and the fourth is usually found dipping into the pelvis. It is reported that the fourth lumbar ganglion contains postganglionic fibers; therefore, it would not seem advisable to remove it because postganglionectomy greatly sensitizes the individual to adrenalin and sympathin.[3] The work of Atlas[4] indicates that it is not necessary to excise the first lumbar ganglion to interrupt permanently the sympathetic supply to the lower extremity.

RESULTS

Twenty-one patients with lower extremity ulcers are included in this series. The classification, distribution, duration of symptoms and results of our treatment on these patients are indicated in Table I.

The entire group had received previous treatment which consisted of one or more of the following: (1) Local applications such as vaseline gauze, wet dressings, gentian violet, sulfonamides, tyrothricin, penicillin; (2) local support including elastic stockings, elastic bandages and unna paste boots; (3) ligation or injection of veins, and (4) skin grafts. The postoperative follow-up period varied from three to twenty-four months. In this series of cases the results are uniformly good, except in one patient with edema following previous thrombophlebitis. However, this patient had a saphenous vein ligation in spite of poor deep venous flow as proven later by phlebography.

TABLE 1

Type of Ulcer	No. of Cases	Duration of Ulcer	Result of Sympathectomy
Stasis	6	3–7 yr.	Good
Arteriolar	4	1–6 yr.	Good
Traumatic	10	1–10 yr.	Good in 9; failure in 1
Cyanosis and dermatitis	1	5 yr.	Good

Stasis Ulcers. Patients are classified in this group depending on the following criteria: (1) History of varicose veins; (2) presence of thrombosed veins and dermatitis about the ulcer; (3) medial location of the ulcer; and (4) inability to find any definite etiological factor.

We studied six patients with stasis ulcers. All had varicose veins and had adequate ligations and sclerosing therapy. All had medial ulcers, although several had ulcers that encircled the leg. Dermatitis in some degree was present in all. One patient, following sympathectomy, refused to wear any supportive bandage and began working ten hours daily. The skin graft was partially lost and it was necessary to place another graft over the ulcer. Better coöperation was obtained this time and the patient wore an elastic bandage for one month. Since then he has required no

bandage and his leg has remained intact and symptom-free. After sympathectomy the ulcers remained healed, the patients resumed their normal activity, and some have been able to discard the supportive bandage. The longest follow-up period is one year and eight months. The following case report is illustrative of this group:

W. M., age sixty-seven, was admitted to the hospital on May 9, 1944, with several ulcers bilaterally. The ulcers were purulent, had sloping edges and measured ½ to 1½ inches in diameter. All cultures revealed mixed organisms. A bilateral high and low saphenous ligation had been performed in June, 1943. He received injections of the veins for three months following this operation. In January, 1944, pinch grafts were placed over the ulcer and they failed to grow. In March, 1944, he received pinch grafts in a doctor's office without any particular benefit. On May 10, 1944, two venous blowouts were ligated. On May 15, 1944, pinch grafts of both leg ulcers were done, but again the ulcers were not improved. On June 10, 1944, skin temperatures of the toes rose 0.5° to 1° following paravertebral procain infiltration of the lumbar ganglia. On June 12, 1944, a left lumbar sympathectomy was done. On June 20, 1944, a right lumbar sympathectomy was done. On June 30, 1944, the ulcers were healed in the left lower extremity on discharge from the hospital. He wore an elastic bandage for two months following the operations. On July 14, 1944, the ulcers of the right lower extremity were healed. His last return visit was July 2, 1945, and the ulcers had not recurred.

Arteriolar Ulcers. The following criteria were present in this group: (1) All were in the fifth or sixth decades; (2) moisture of the feet was marked; (3) pulsations in the foot, which were originally barely palpable, became definite and accentuated following paravertebral block; (4) all of the ulcers were located over the anterolateral aspect of the lower leg; (5) all had previous treatment, including (1) local sulfonamide, (2) elastic support, and (3) skin grafts; (6) a history of trauma was present in all.

There were four patients in this group, and their ages ranged from fifty-four to sixty-eight. Results were good in all. The longest follow-up was two years. All were males. The following case report serves as an example of this group:

W. M., age fifty-five, was admitted on July 27, 1944, with an ulcer on the antero-lateral aspect of the left ankle. He stated that about June, 1943, he developed a small pin point bruise on the anterior aspect of the left ankle because of a shoe that was too tight. He consulted his doctor who prescribed a sulfonamide ointment and told him to buy a larger shoe. The area became red, then blue in color; and finally the skin came off and there was an ulcer one inch in diameter. He used wet soaks of epsom salts, applied the sulfonamide ointment every evening and wore an elastic bandage. The ulcer became larger, so he went to bed for two weeks. There was no improvement and a skin graft was done without benefit. On admission he presented an ulcer involving the external malleolus with an associated cellulitis and lymphangitis. Penicillin, 250 units per cc. was used locally and sulfadiazine gr. 60 was given daily. On August 26th, a skin graft was done with a 75 per cent take. A paravertebral block was done on September 9th and there was an increase in pulsations with an elevation of 0.5° in the skin of the toes. A left lumbar sympathectomy was performed on September 12th. There was rapid healing and he was discharged on September 23, 1944, with the ulcer entirely healed. On August 26, 1945, his last check-up revealed a healed ulcer.

Traumatic Ulcers. Patients were classified in this group depending on the following criteria: (1) History of trauma; (2) following burns, or the injection of a chemical agent; (3) associated with severe fractures or following an amputation; and (4) thromboses of the smaller veins and arteries with *secondary infections* present.

There were ten patients in this group. Duration of symptoms was from two to ten years. The age group ranged from thirteen to fifty-eight. The results are listed in Table I. One patient was con-sidered a complete failure. This patient had an ulcer of the left ankle. The ulcer was present over ten years and followed an injury of the tibia. He was treated with ointments and elastic support with no success. The ulcer encircled the left ankle when we first saw him. The left thigh and leg were larger in circumference by three and one and one-half inches, respectively, than the right lower extremity. Pinch grafts failed on two occasions. Skin temperatures rose 0.5° following paravertebral lumbar block with procain, and he was subjected to sympathectomy. The ulcer diminished in size, but when he became ambulatory the ulcer became worse. There were a number of superficial varicosities present and a high saphenous vein ligation was done. The ulcer did not improve. It was believed that a deep venous block was present and this was proven by phlebography.

CASE REPORTS

W. M., age fifty-two, was admitted September 26, 1944, with ulcers of both ankles. In 1921, he suffered a fracture of the right ankle. He was in the hospital eleven months at that time. In 1929, he developed an ulcer of the left ankle. On admission, there were ulcers of the right ankle which measured from ½ inch to 1½ inches in diameter. Many smaller ulcers over the left ankle were also present. Cultures revealed mixed organisms. On September 28th, skin temperatures were recorded before and after paravertebral lumbar block with 1 per cent procain. Dryness of the skin was definite on palpation, but there was no elevation of skin temperatures. On September 30th, paravertebral block was repeated with similar results. On October 3rd, a right lumbar sympathectomy was performed, and on October 10th, a left lumbar sympathectomy was performed. On October 21st, there was spontaneous healing of all the ulcers. He was discharged on October 25, 1944. The ulcers remained healed up to August, 1945.

B. F., age fifty, was admitted, on May 22, 1944. In 1937 she injured the lower left leg. Following the injury, she developed recurrent ulcers on the medial aspect of the lower third of the leg for which she had various forms of treatment. She also complained of having a

swollen, painful extremity, with tenderness along the medial surface of the thigh developing shortly afterward. She was treated with bed rest, elastic bandage and ointments, and stated that there was improvement as long as she remained off of her feet. She received twenty-one diathermy treatments in 1941. She was admitted with an ulcer 2½ inches in diameter on the medial aspect of the lower third of the left leg. Pulses were normal. There were no palpable veins about the ulcers, nor were there varicosities. The left calf and ankle were one inch greater in diameter than the right. There was a 1.0° rise in temperature of the left lower extremity following paravertebral lumbar block with procain.

On June 1, 1944, a left lumbar sympathectomy was performed. She was discharged fourteen days later with the ulcer almost completely healed except for an area about ¼ inch in diameter in the central portion. Two weeks following discharge, she was seen in the Out-Patient Department and the ulcer was healed. This patient had worn supportive bandage for six weeks following the operation. She was last seen in the Out-Patient Department fifteen months following the operation and the ulcer had remained healed. Both extremities, measured at fixed levels, were equal.

Cyanosis and Dermatitis. One patient had marked cyanosis of the right thigh and leg with ulcers of the right ankle. This white male had high and low saphenous vein ligations in 1937. In 1939, he developed cyanosis of the entire right lower extremity and scaling of the lower third of the right leg. He was treated at several local hospitals for a skin condition. In 1940, he developed a small ulcer on the medial malleolus. This ulcer gradually increased in size, and in 1941 he had two ulcers, ½ inch in diameter. In March, 1945, when we saw him, there was cyanosis of the right thigh and leg. The cyanosis was not affected by changes in position or temperature. There was a dermatitis involving the right leg. There were two ulcers of the ankle, each measuring approximately ⅘ inches in diameter. He was treated for three weeks by the dermatological department with no change in the size or appearance of the ulcers.

He was examined repeatedly for varicose veins but none were found. Paravertebral lumbar block was performed three times. There

was a 0.5° to 1° rise in skin temperatures following each lumbar procain block. A right lumbar sympathectomy was performed in April, 1945. Two weeks after the operation the ulcers showed definite improvement with diminution in size. Four weeks postoperatively the ulcers were healed, but the dermatitis persisted. All medication was discontinued and in August, 1945, the cyanosis had disappeared, the ulcers were healed, and there was no evidence of dermatitis.

COMMENT

We are fully aware of the fact that most ulcers of the lower extremities will heal with conservative measures. Quite often an ulcer of the lower extremity is found on a leg which exhibits considerable vasospasm as shown by moist skin and absent pulses, which become palpable following paravertebral lumbar block with procain. Pinch grafts usually fail in these ulcers, but, if infection and small vessel thrombosis are eliminated, sympathectomy as an additional therapeutic aid should be given consideration.

In this group of twenty-one patients, lumbar paravertebral block with rise in skin temperatures has been used as a criterion to select the patient for sympathectomy. In several patients manifestation of a dry skin following paravertebral block was used as a criterion for lumbar sympathectomy. Again, it should be stressed that failure to respond to adequate conservative measures is a secondary criterion for consideration of lumbar sympathectomy. Loss of working hours can mount rapidly due to painful leg ulcers that do not respond to conservative therapeutic measures. The individual has a definite handicap, and economically may be benefitted by sympathectomy.

Mortality and morbidity statistics will increase as this procedure regains popularity. It is our belief that the operation is a safe procedure.

Following sympathectomy, we have advised this group of patients to wear adequate elastic support if pinch grafts were used. Cleanliness of the feet has been

stressed (cleansing with lukewarm water and the use of clean stockings daily). Instructions in the proper care of the nails should be given.

If the patient's general condition does not warrant a major surgical procedure, lumbar paravertebral injection with alcohol may be indicated. However, in our experience, the only contraindication to operation has been serious cardiovascular disease.

SUMMARY

Lumbar sympathectomy is of definite value in the management of intractable ulcers of the lower extremity. Criteria for operation are given. Removal of the second and third lumbar ganglia is satisfactory for sympathetic denervation of the lower extremity. We report a series of twenty-one cases in which the patients were treated under these principles and the results have been gratifying. Table 1, showing the type of cases, distribution, duration of symptoms, and result of the treatment is included.

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Treatment of secondary malignancy of bone is palliative. Support and fixation should be used for fractures; irradiation, opiates, nerve blocking, chordotomy or rhizotomy for the pain.

From "Principles and Practice of Surgery" by W. Wayne Babcock (Lea & Febiger).

TRIMALLEOLAR FRACTURES OF THE ANKLE JOINT*

A CONSERVATIVE METHOD OF TREATMENT

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A TRIMALLEOLAR fracture, so named by Henderson,[13] is a serious injury of the ankle joint, consisting of a fracture of the internal and external malleoli, a fracture of the posterior inferior articulating surface of the tibia, (the posterior surface of the roof of the ankle joint), and a posterior dislocation or subluxation of the foot. The astragulus is pulled upward and backward with the tibia and fibula being shunted forward and coming to rest on the neck of the astragulus instead of on the trochlea. There is also an extensive tearing of the ligaments of the ankle joint as well as the soft tissues as indicated by the excessive swelling, edema, and ecchymosis about the ankle and foot. The larger the posterior tibial fragment, the greater generally the amount of displacement, and therefore the more difficult the reduction and the maintenance after reduction.

Ashurst,[1a] in a masterly article on ankle fractures, gave an excellent description of this lesion and an extensive review of the literature. This fracture is commonly referred to as "Cotton's Fracture," although it appears to have been first reported by Sir Cestley Cooper in 1822, because Dr. F. J. Cotton[1b] observed and accurately described it in a series of cases studied between 1903 and 1915. He emphasized the important details of this type of fracture. Despite the writings of earlier men, these fractures were still being called "Pott's fractures" and "Reversed Pott's fractures." The results of treatment were as a rule unsatisfactory. With the advent of the x-ray, the diagnosis became much easier and the treatment

more satisfactory, because the pathological picture could be clearly visualized.

We must bear in mind that this type of fracture is accompanied by a posterior dislocation of the foot. A Pott's fracture is an outward subluxation and a reversed Pott's fracture is an inward displacement. The necessity for correction of these displacements must be constantly borne in mind to obtain satisfactory end results for a good walking foot. This is of great importance because the gravital stress from the superincumbent body weight reaches the foot through the tibia and the body of the astragulus. The center of the body of the astragulus is the mechanical center of the system, for from it the pressure stresses are transmitted forward and backward to the anterior and posterior portions of the long arch. At the points of contact with the floor, counter resistances are created at the ball of the foot and the heel.

In recent years numerous discussions of "trimalleolar fractures" have appeared in the literature, the very variety of treatments proposed attesting to the frequency of unsatisfactory end results. By far the majority of later authors recommend some form of operative reduction and internal fixation, notably Lewin,[17] Lee and Horan,[16] Nelson and Jensen,[22] Lounsberry[18] and Metz,[20] Batchelor,[1b] and Gillette.[11] Review of standard textbooks on the treatment of fractures reveals that all authors stress the difficulty of managing this lesion satisfactorily by conservative means. The following authors state that in the event of failure of manipulation, usually to be expected in the more severe

group of trimalleolar fractures, open operation and nailing should be resorted to: Geckeler,[10] Magnuson,[20] Speed,[25] Camp-

closed manipulative reduction to be followed by cast application. Similarly Henderson,[12] Tobin,[29] Carothers,[4] Lavender,[15]
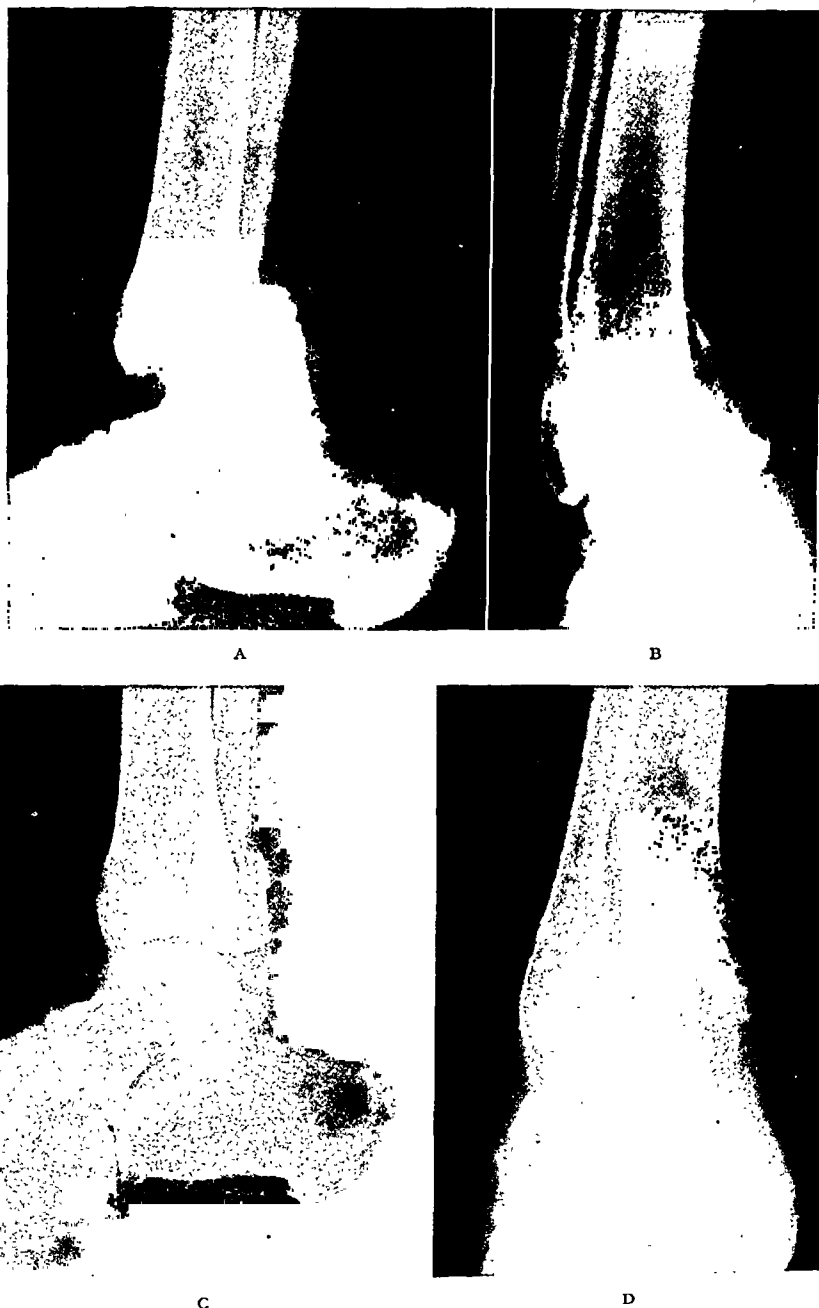
FIG. 1. First degree: A, lateral view, before reduction; B, anteroposterior view, before reduction. These show: (1) A small chip fracture off the posterior articulating surface of the tibia; (2) a fracture of both malleoli; (3) a partial subluxation of the foot. C and D, Post-reduction, satisfactory alignment of the fragments. Treatment consisted of anesthesia, local or general, manual reduction and cast.

bell,[3] Steindler,[26] and Key and Conwell.[14] Watson-Jones,[30] Scudder,[23] and Boehler,[2] on the other hand, recommend simply

and Darrach[8] advocate a relatively conservative approach without open operation. Dieterle[9] recommends percutaneous

nailing and fixation of the fragments by means of a Kirschner wire, whereas Mackinnon[19] takes the somewhat extreme view that arthrodesis of the ankle joint is the procedure of choice.

Some ten years ago we adopted, as our routine method in the handling of these cases, a two-pin procedure utilizing a mechanical distraction apparatus, with gratifying results. In 1937, the senior author presented a paper on this mode of treatment and its satisfactory end results before the Brooklyn Surgical Society. As noted below, at that time only one other author, whose work appeared in publication sometime after we had independently developed the technic, appeared to have adopted a similar approach. Since our original work, however, several reports have appeared describing much the same treatment. Nelson and Jensen[22] disagree and prefer operative reduction to this manipulation, although they discuss a very small group of classical trimalleolar fractures. Lavender and Darrach,[15] however, agree with the present authors that successful reduction and restoration of function can be achieved by a two-pin technic and the use of special traction apparatus.

The incidence of trimalleolar lesions has been reported as 16.5 per cent of ankle fractures by Henderson,[12] who stated that only one case in his series required open reduction. Mackinnon[19] found this fracture to occur in 10 per cent. Tobin[29] describes what we term a first degree trimalleolar fracture as "paratrooper fracture." In the Nelson and Jensen[22] series of 359 ankle fractures, seventy-seven minimal and ten classical instances (i.e., where one-third or more of the posterior inferior articular surface of the tibia was involved) were found. They point out that minimal cases do not need accurate anatomic reduction of the posterior malleolus, but that in the more severe type perfect reduction is an absolute essential of the ten cases of the latter type. Satisfactory results appear to have been attained in only three.

Anatomy. Under this heading we will describe only the ankle joint proper, disregarding the anatomy of the foot distal to it. The ankle joint is formed above by the tibiofibular mortise and below by the trochlea of the astragulus which fits into this mortise. This trochlear surface is one-fourth wider in front than behind, conforming to the divergent direction of the internal surfaces of the malleoli. The inferior articular surface of the tibia may be described as the roof or ceiling ("plafond") of the joint; and the articular surfaces of the malleoli have long been known as the "cheeks" of the mortise. That portion of the fibula, which projects beyond the tibial plafond, is properly called the external malleolus and the corresponding projection of the tibia is called the internal malleolus. The posterior tibial projection reinforces the mortise posteriorly. This posterior articulating margin of the tibial plafond is longer and projects farther downward than is generally supposed (both Destot and Henderson[12] have termed it the "posterior mallelous"), and is therefore particularly prone to injury.

The ankle joint is further deepened by the especially strong and tough transverse tibiofibular ligament which extends from the external malleolus to the posterior lip of the fibula, this way holding the surfaces of contact of the lower ends of the fibula and fibula firmly together. Thus, in walking, as the foot meets the ground in plantar flexion, the tibia and fibula are checked in their tendency to slide forward on the wedge-shaped astragalus (narrower posteriorly and wider anteriorly) by the corresponding divergence of the anteroposterior planes of the malleoli and by the long posterior marginal surface of the inferior aspect of the tibia.

The fibula is firmly attached to the tibia; nevertheless a slight range of motion is permitted. At the upper end of the leg, where the head of the fibula abuts the overhanging external condyle of the tibia there is a synovial cavity, but at the ankle

C   D
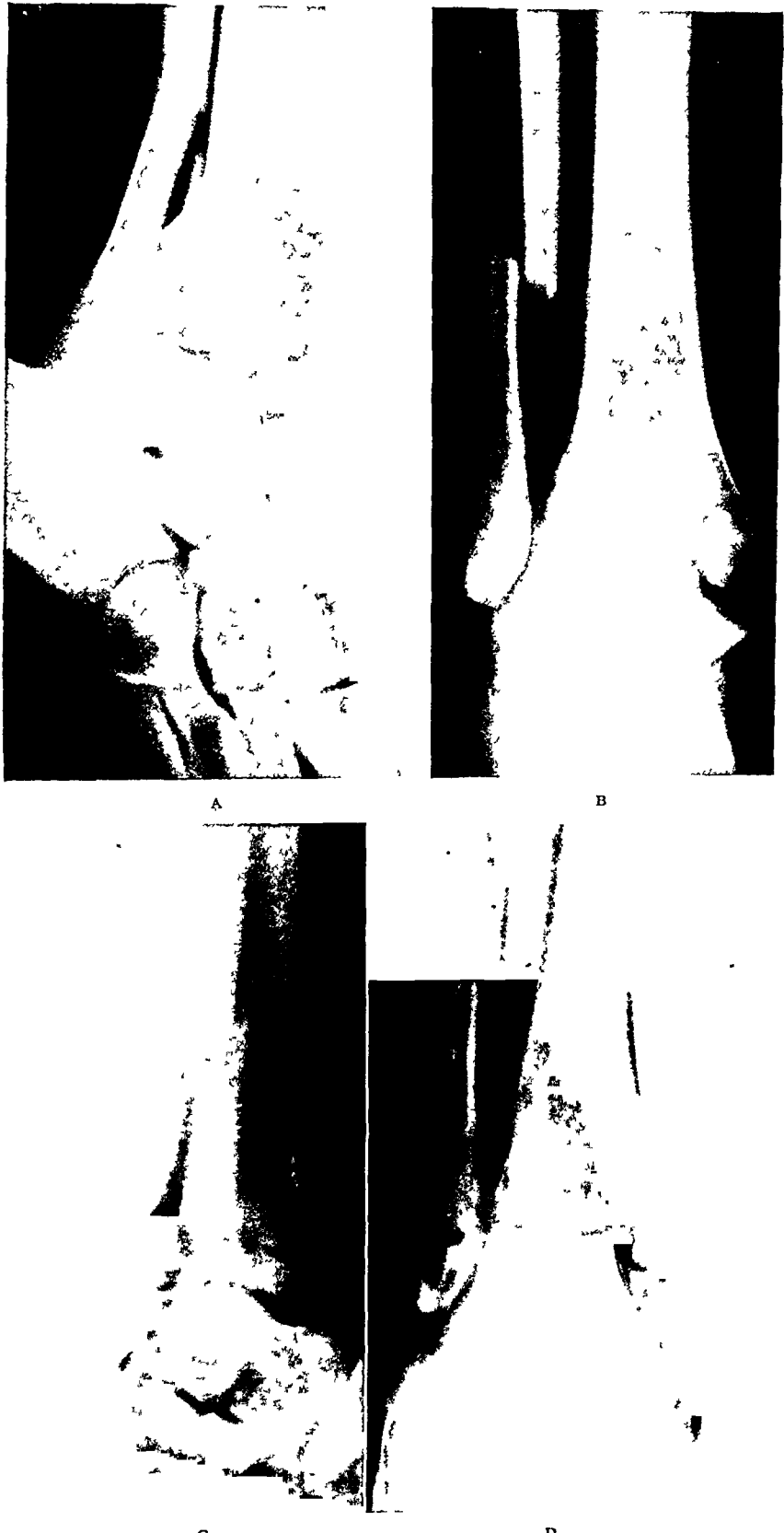
Fig. 2. For legend see opposite page.

no such cavity is present at the tibiofibular junction. Here, it is reinforced by the anterior inferior tibiofibular ligament and the posterior inferior tibiofibular ligament. The external malleolus is longer than the internal malleolus and is situated more posteriorly, serving to keep the foot under the leg bones.

The foot is attached to the tibia and fibula by ligaments which restrict or limit motion, except in the anteroposterior plane. The internal lateral ligament (deltoid) is a heavy mass of fibers which spread out fan-wise, radiating from the internal malleolus anteriorly to the scaphoid and median surface of the calcaneus (sustentaculum tali) and posteriorly to the median tubercle on the posterior surface of the astragalus. The external lateral ligament is the weaker of the two and has three distinct bands passing from the external malleolus: the anterior goes forward to the lateral border of the neck of the astragulus; the middle band passes downward and slightly backward (above the sinus of the tarsus) to the calcaneum (os calsis); and the posterior, whose deep portion is extremely strong, is attached to the tubercle on the posterior surface of the astragulus (os trigonum). This powerful posterior band is seldom ruptured; it holds the astragalus almost indissolubly attached to the external malleolus. The astragalus itself has no muscular attachments and serves as a ball in a ball-bearing joint to facilitate the movements of the leg bones above it and the tarsal bones below and distal to it.

The normal movements of the ankle joint are those of flexion and extension—twenty degrees of dorsi-flexion and sixty degrees of extension or plantar flexion—a total range of approximately eighty degrees. Plantar flexion is carried out by the triceps surae muscles, composed of the soleus and gastrocnemius. The soleus, arising from the posterior surface of the tibia and interosseous membrane, and the gastrocnemius, arising from the posterior surface of the condyles of the femur, unite into a common tendon, the tendo Achilles, which is inserted into the posterior and superior surfaces of the os-calcis. The long flexor of the toes, the flexor hallucis longus, and the tibialis posticus and peronus longus assist in plantar flexion.

Dorsiflexion of the foot is carried out by the tibialis anticus, the extensors to the toes, and the peroneus tertius. These muscles come from the anterior surface of the leg and are inserted respectively into the scaphoid and base of the first metatarsal (tibialis anticus), into the dorsal extension aponeurosis of the toes (long extensor of the toes), and into the fifth metatarsal (peroneus tertius). To their action is added that of the long extensor of the big toe, arising from the interosseous membrane and anterior surface of the fibula and inserted into the base of the second phalanx of the big toe.

Mechanics of Production. It is evident that the mechanics of production of this fracture, which is one of the most frequent of all fractures of the ankle (about 25

FIG. 2. Second degree: A, lateral view, before reduction; B, anteroposterior view, before reduction. These show: (1) A large fragment off the posterior articulating surface of the tibia (about one-third of surface), with marked separation of the tibial fragment (the so-called "3rd or posterior malleolus"); (2) a downward displaced fracture of the internal malleolus; (3) a fracture of the fibula at the junction of the middle and lower thirds; (4) a marked posterior displacement of the foot; (5) a moderate lateral displacement of the foot. (In the classical type of trimalleolar fracture, the fibular fragment is at about the lower 1 ½ inches of the fibula.) C and D, Post-reduction, showing satisfactory alignment of the fragments and reduction of the posterior displacement of the foot. In this case a tenotomy of the tendon Achilles was performed. Treatment consisted of anesthesia, local or general, tenotomy of the tendo Achilles, skeletal traction, Steinman pins on a McMillan distraction apparatus, immobilization, and cast.

A

B

C

D
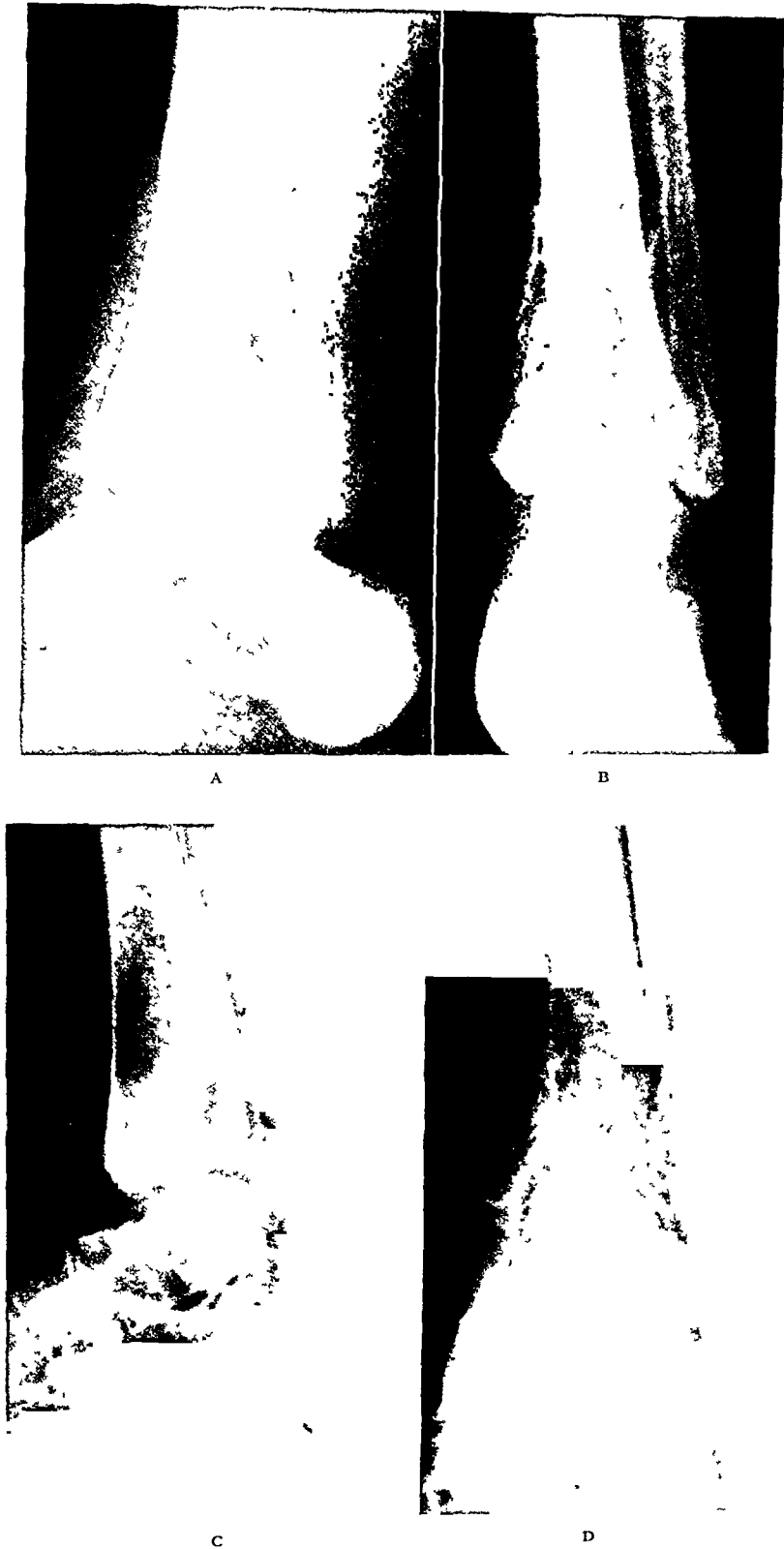
FIG. 3. For legend see opposite page.

per cent), involves not only a push outward on the anterior border of the external malleolus, but also a full inward push on its posterior border by means of the posterior band of the external lateral ligament. It is, properly speaking, a spiral fracture produced by torsion, the obliquity of application varying greatly, but acting always higher on the posterior surface of the fibula than on its anterior surface. The line of fracture passes through and involves the inferior tibiofibular joint. Almost invariably, its lower and anterior end extends to the external malleolus, often just below the tibial plafond, sometimes as far down as the very tip of the malleolus.

Thus, in practically every instance, the anterior inferior tibiofibular ligament remains intact for, even if partially ruptured, there results no real diastasis between tibia and fibula. At most, the lower fragment, comprising that part of the fibula posterior to the attachment of the anterior tibiofibular ligament, rolls outward and slightly backward around the unruptured posterior tibiofibular ligaments as a hinge.

The foot being extended or plantar flexed with some outward rotation, the astragalus is driven against the posterior articulating margin of the tibia (posterior malleolus) which is broken off, and when the action of the force has continued after this fracture has taken place, a posterior dislocation of the astragulus may result. On x-ray examination, the anteroposterior views may simulate a Pott's fracture, but the lateral views show a different picture; the posterior marginal surface of the lower end of the tibia is pulled up and we have a backward or posterior subluxation of the foot, due to a combined outward twist of the foot with a forward thrust of the body weight transmitted through the tibia. (Figs. 1A, 2A and 3A.)

The lesion comprises a fracture of the fibula at or close to the joint level, a breaking off of the internal malleolus and a breaking away of the postmarginal surface of the tibia. Commonly enough, the tibial edge and the malleolar fragment are broken away in one piece, but even more often in two separate fragments. The internal malleolus gives way and is pried loose. The fracture line runs upward and inward.

Examination and Diagnostic Features. (1) The anteroposterior diameter of the ankle joint is increased. (2) There is ecchymosis and tenderness on palpation behind the internal malleolus. (3) The foot is held in extension (plantar flexion); dorsiflexion of the foot is restricted and painful. (4) In posterior subluxation of the foot (astragulus) the prominence of the heel is pathognomonic. (5) The x-ray examination confirms findings.

Classification and Treatment. In the past eight years at the Cumberland Hospital, we have seen some thirty-three trimalleolar fractures of the ankle joint, all of which have presented some degree of posterior displacement of the foot. We have encountered the greatest difficulty in those cases in which more than one-third of the lower articulating surface of the tibia was fractured, since these were more difficult to reduce and it was equally difficult to maintain the fragments in satisfactory alignment. After using the established methods for the reduction of this type of fracture, we concluded that skeletal traction applied in opposite direc-

Fig. 3. Third degree: A, lateral view, before reduction; B, anteroposterior view, before reduction. These show: (1) A large fragment off the lower posterior articulating surface of the tibia; (2) a comminuted fracture of the lower third of the fibula and internal malleolus; (3) a comminuted fracture of the external malleolus; (4) the tibia resting on the neck of the astragulus; (5) a posterior dislocation of the foot. C and D, Post-reduction, showing a satisfactory reduction of the fracture with good approximation of the fragments and restoration of the ankle mortise. A tenotomy of the tendo Achilles was necessary in this case.

tions at the same time would be the procedure of choice.

Inquiries were made of several sources, after review of the literature, but none utilized this procedure except Crasson[7] who first mentioned this method in 1937. We began using this technic in 1936, unaware of Crasson's similar work. Our original paper was read before the Brooklyn Surgical Society on February 4, 1937.

After a careful study of many cases, it was found that the treatment must be varied with the degree and amount of posterior displacement of the astragalus and the size of the fragment of the tibial articular surface, the fractures of the malleoli being a constant factor. In view of the important inter-relationship between treatment and the degree of displacement, these factors were selected as a basis for a new classification of trimalleolar fractures by the author, and herein described.

Classification:

1st degree—(a) A small chip fracture of the lower posterior articulating margin of the tibia. (Fig. 1A.)

(b) Partial displacement of the foot (astragalus).

2nd degree—(a) Fracture of about one-third of the lower posterior surface of the tibia. (Fig. 2A.)

(b) Partial subluxation of the foot (astragalus).

3rd degree—(a) Fracture of one-half or more of the lower posterior articulating surface of the tibia.

(b) Practically a complete posterior dislocation of the foot, the fractured tibial surface resting on the neck of the astragalus. (Fig. 3A.)

It must be remembered, that in the treatment of each of these types, accurate anatomic alignment of the fragments from the moment of reduction until union has taken place must be obtained and maintained; *this accurate reduction is essential.* Great care and vigilance are required in the treatment of these fractures, as slight errors in reduction are always disastrous, more especially the incomplete reduction of the

posterior displacement of the astragalus, since it results in a stiff and painful ankle joint. Direct weight-bearing during the healing period tends to produce a bad walking foot, and therefore weight-bearing must be interdicted.

The fragments must be separated so as to enable the surgeon to replace the astragalus properly into the mortise to give a good walking foot. This may be accomplished: (1) Manually; (2) mechanically—skeletal traction, wire pins, (solid or jointed); (3) surgically—open reduction, arthrodesis.

SPECIFIC TREATMENT OF EACH TYPE OF FRACTURE

First Degree. In this class, without much posterior displacement, if the treatment is instituted immediately, i.e., before much effusion and subcutaneous hemorrhage has taken place, manual reduction under anesthesia will suffice.

The patient is given a general or local anesthetic. The reduction is effected by flexing the injured leg on the thigh and the thigh on the abdomen. This relaxes the gastrocnemius and Achilles tendon. The heel being placed in the operator's palm, the assistant makes countertraction on the thigh while the operator pulls and makes traction on the heel, pulling the foot in the direction of the long axis of the tibia, and then upward. A characteristic grating sensation is felt as the astragalus slips into the mortise of the joint. The foot is then dorsiflexed to about 100 degrees and pressure is made over both malleoli to reduce the width of the ankle joint, thus approximating the fractured malleoli. A cast is then applied extending from below the knee to the toes, maintaining this degree of dorsiflexion and slight inversion of the foot. No weight-bearing is permitted for at least eight weeks, although a walking iron may be used.

Second Degree. A general or local anesthetic is administered and manual manipulation is attempted as previously described. If this fails, skeletal traction is attempted,

and sometimes a tenotomy of the Achilles tendon is performed for a proper reduction. For the skeletal traction, the Kirschner wire or Steinman pin is used. We prefer the solid pin to the jointed one, since the latter bends and breaks easily within the bone. We advise a skeletal distraction method; we make use of the MacMillan apparatus. With this method we have never had recourse to open operative treatment in a series of thirty-three trimalleolar fractures. The distraction method works on the principles that the impaction is broken up, the fragments are separated, and the posterior displacement of the foot is reduced. This permits accurate reduction, accurate control of the involved osseous structures, firm fixation (a plaster cast is easily applied without fear of disturbing the alignment of the fragments or disturbing the mortise of the joint) and hospitalization is reduced. Early ambulatory treatment may be instituted by the incorporation of a walking iron into the cast.

Procedure. To obtain local anesthesia, 10 cc. of 2 per cent procaine solution is injected into the upper one-third of the leg, over the tibia, about three fingers' breadth below the knee joint posterior to the tibial tubercle. A hole is drilled through the tibia at this point, and then a $\frac{5}{32}$ inch Steinman pin is inserted. A drill is used here because the bone at the upper end of the tibia is very hard. This procedure greatly reduces the trauma, and the pin is inserted through the middle one-third of the os calcis. This latter site is chosen for the following reasons: If an imaginary line were to be drawn from the tip of the external malleolus to the tip of the heel, and this line were divided into three equal parts, the following would be the anatomical distribution resulting: the proximal one-third is the location of the tibial vessels, the distal one-third consists only of soft tissue, and the middle third, where the bone is most superficial and free from any significant structures, hence ideally suited for insertion of the pin.

With the pins in place, collodion and sterile gauze pads are spiked over the pins, sealing the skin surfaces about the protruding pins. Four ferrules are now slipped over the protruding ends of the pins and the ferrules are then placed on the MacMillan apparatus. The pin through the os calcis lies on a level $\frac{1}{2}$ inch lower than the long axis of the tibia.

With everything now in readiness for reduction, the necessary mechanical adjustments are made. Impaction must be broken up and the fragments separated, checking by frequent use of the fluoroscope. While traction is being made, an assistant makes firm pressure on the shaft of the tibia as the foot is being dorsally flexed. When traction is completed the foot may be elevated and when the astragalus is opposite the articulating surface of the tibia the traction is released, and the astragalus then enters the mortise of the ankle joint.

The foot is now inverted or elevated and pressure is made over the fractured malleoli molding them into satisfactory alignment, thereby reconstructing the mortise. To obtain this reduction, the fragments must be clear of the joint surfaces. If too much traction has been applied, free bleeding is noted from the site of the pin through the os calcis. However, when the traction is relaxed, the bleeding ceases.

Retention and immobilization are now maintained by a cast extending from the upper third of the thigh to the toes with the pins incorporated into the cast. The foot is held at 100 degrees dorsiflexion, in inversion or eversion as required for the fractured malleoli. When the cast has hardened, the limb is removed from the apparatus. The patient is allowed out of bed the next day. The pins may remain *in situ* ten days to three weeks or longer.

Third Degree. In this type there is a complete posterior dislocation of the foot. The treatment is the same as that for the second degree, except that frequently it is necessary to do a tenotomy of the tendo Achilles before a satisfactory reduction is obtained.

We have accepted the MacMillan apparatus for this method because of the

following advantages: The risks of using a general anesthetic are avoided; patients are not bed-ridden, thereby lessening the risk of pneumonia and decubitus ulcers; patients are more content and comfortable; the nursing task is lightened; and finally the period of hospitalization is shortened.

Postoperative Care. One must be on the lookout for a loosening of the cast, resulting in improper immobilization. Within ten days after the reduction and application of the cast, there occurs a subsidence of the swelling and edema and this is followed by an atrophy of the soft parts, converting a snug-fitting plaster cast into a loose covering. If one is not alert to these minute details, the perfectly reduced fracture may undergo redisplacement and result in a malunion at the end of six weeks. Frequent x-rays are therefore essential. Too early weight-bearing and a loose cast almost always result again in displacement of fragments.

We believe that in order to obtain ultimate good results, the pins should be incorporated in the casts for three or four weeks or longer, thereby obviating any displacement of the fragments despite the subsidence of the swelling and atrophy of the soft parts.

Results. Our own series of patients treated in accordance with the principles outlined above consisted of thirty three cases seen during an eight-year period. Four were of the third degree or most serious variety, twenty-three were second degree, and six were of the first degree. The relatively small number in the last group can largely be attributed to the fact that prolonged hospitalization is sought less often by the industrial or indigent group who comprise our hospital material with less serious injuries. Good functional results during and after the usual period of convalescent observation were secured in all cases except one patient who transferred early to another institution. In twelve follow-ups this result was maintained. The remaining number were lost sight of after several months, after which

time complications are not usually to be expected.

SUMMARY

1. The trimalleolar fracture is defined and classified.

2. Careful correct diagnosis has revealed that the trimalleolar fracture is more common than previously supposed.

3. Failure to diagnose the fracture properly contributes to the poor results so commonly obtained.

4. Use of the MacMillan apparatus for distraction is advocated and its advantages presented.

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SURGICAL treatment of infections of the costal cartilages is frequently unsatisfactory and repeated operations may be necessary to effect a cure. Hygienic and specific types of therapy should be combined with surgery.

From "Operations of General Surgery" by Thomas G. Orr (W. B. Saunders Company).

THE USE OF OXYGEN AND OXYGEN LIBERATING SUBSTANCES IN THE TREATMENT OF ANAEROBIC PERITONITIS IN GUINEA PIGS*

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PRIMARY peritonitis is that type which is due to pathogenic bacteria that have reached the peritoneum by way of the blood stream, a single species of bacteria such as the pneumococcus or streptococcus being responsible. Secondary peritonitis is due to pathogenic bacteria which have reached the peritoneum through breaks in the continuity of the gastrointestinal tract, more than one species of bacteria being responsible through their combined effects. Extension of infection from adjacent abscesses may also bring about a secondary type of peritonitis. Accidental and surgical wounds may likewise introduce bacteria into the peritoneal cavity which result in secondary peritonitis.

From time to time articles have appeared in medical literature which cite cases of "Gas Peritonitis" or "Anaerobic Peritonitis." Differences of opinion exist over the ability of strictly anaerobic bacteria to produce peritonitis without being in association with other bacteria.

Bacteria reported to be present in the exudate of secondary peritonitis include colon bacilli, streptococci, staphylococci, Welch bacilli and anaerobic non-hemolytic streptococci. A summary of the literature reviewed reveals conflicting opinions on the existence of "Gas Peritonitis" or "Anaerobic Peritonitis" as an entity.

Veillon and Zuber[30] are generally credited with being the first to isolate an anaerobic non-hemolytic streptococcus under the name of Micrococcus faetidus, a strictly anaerobic coccus growing in short chains and producing gas and a fetid odor in cultures. This organism had been isolated in pure culture from a case of suppurative bartholinitis, and in association with other organisms from cases of appendicitis, Ludwig's angina and perinephritic abscess.

Since Veillon's report there have appeared in the literature numerous articles, some reporting series of cases, others dealing with isolated observations on the recovery of anaerobic non-hemolytic streptococci in pure culture and in association with other organisms from various lesions, as well as from healthy body cavities and surfaces. Tissier[29] was able to isolate from cases of putrid enteritis anaerobic non-hemolytic streptococci which he described as a new species under the name of Lanceolatus anaerobicus.

While undoubtedly the anaerobic streptococcus is a normal inhabitant of the human gastrointestinal tract, it is possible that some may be introduced from the mouth in the process of swallowing saliva. McDonald, Henthorne and Thompson[18] reported a case of perforated duodenal ulcer which was followed two and one-half months after surgical closure by a subdiaphragmatic abscess, empyema thoracis, and multiple liver abscesses. The anaerobic non-hemolytic streptococcus was obtained in pure culture from the latter. Presumably the organisms originated from the spilled duodenal contents.

Gilbert and Lippman[11] recovered these organisms in 25 per cent of their cases of suppurative cholecystitis. There is an abundance of literature on the bacteriology of acute appendicitis, and numerous investigators[1,2,4,12,21,32] have shown that the anaerobic non-hemolytic streptococcus forms part of the bacterial flora of acute suppurative appendicitis, gangrenous appendi-

citis, and perforative appendicitis with peritonitis or abscess. The literature is apparently devoid of any description of a case of diffuse peritonitis in which the anaerobic non-hemolytic streptococcus was the sole etiological organism.

W. Lohr[14] reviewed the subject of "Gas Peritonitis" in all its phases in 1929. He stated that it is a very peculiar though typical disease picture and apparently rare, usually following laparotomy. The intestines are compressed and collapsed by gas in the abdomen. Gross inflammatory changes are lacking. He refers to one case arising spontaneously in which at operation the peritoneal cavity was found filled with gas. The intestines were normal but the appendix, which was removed, was reported by the pathologist to be in an acute stage of inflammation. No cultures of the peritoneal exudate were made.

Michedjas[22] reported, in reliable cases in which pure cultures of anaerobic organisms were obtained, in man and animals the peritonitis began with an exudate, poor in cellular constituents without excessive accumulation. A gas edema or gas phlegmon of the stomach or intestines corresponding to a muscular gas edema had never occurred. He found that much larger numbers of anaerobic bacteria were required to produce a peritoneal infection than a muscular infection and the peritonitis if produced was always without gas formation. His explanation was that gas occurs only when anaerobic bacilli can produce necrosis in the tissue infected and thereby produce gaseous decomposition. The fine distribution of toxin in the peritoneal cavity and the excellent blood supply allows rapid absorption and can lead to a dangerous effect. This in turn can be expressed only in capillary paralysis with large exudations of a pale or very hemorrhagic substance with few, if any, leukocytes. Thus from these statements one must assume that Welch bacilli are not a cause of purulent peritonitis.

The nutrition of the intestines of man and experimental animals is so secure that there is neither necrosis nor gaseous dis-integration of these organs during life without trauma or loss of blood supply.

Lohr[15] reporting again in 1933 criticized the report of a case of "Gas Gangrene" of the gallbladder by Koch.[13] Lohr[15] maintained that gas gangrene of the intestines, gallbladder and liver does not exist, and that neither does anaerobic peritonitis exist, as he could show by numerous references to the literature as well as in his own animal experiments and those of others.

Plath,[24] in 1934, collected ten cases of what he called gaseous peritonitis from the literature and classified them in three groups: (1) Following operation within or outside of the peritoneal cavity; (2) spontaneous, when apparently an inflammatory factor is presented; and (3) from the gastrointestinal tract through a perforation or intact walls. He reported a case of the third group, but since a mass was palpable in the upper abdomen, after a fistula was established, the gas was apparently secondary to a perforation. An autopsy was not permitted.

Lamprecht,[16] in 1928, stated that primary gas gangrene of the gastrointestinal canal is very rare but does occur, and refers to five cases described in the literature.

Nason and Starr[22] presented an excellent general discussion of the subject of "Gas Bacillus Infection" complicating laparotomy, in which they stated that the infection may begin in the muscles of the abdominal wall, the peritoneal cavity or the liver, and that the pathological changes are the result of toxemia alone or in addition to the presence of organisms and gas.

Maguire,[17] in 1934, reported that gas gangrene may occur subsequent to appendectomy, hernioplasty and other operations performed on organs in close proximity to the gastrointestinal tract.

Finesilver,[10] writing in 1934, says in his discussions: "The Welch bacillus is in association with other bacteria in the production of gas gangrene, a saccharolytic group starting and a proteolytic group completing the destruction of tissues which

make possible their growth. The Welch bacillus elaborates a hemolytic toxin which produces further local destruction of tissue, absorption of these products causing remote constitutional symptoms."

Supporting the theory of symbiosis in relation to peritoneal infections Meleney, Olpp, Harvey and Zaytseff[21] concluded from their studies that the bacteria commonly found in peritoneal exudates, namely, colon bacilli, streptococci and Welch bacilli, have a synergistic action in producing a lethal infection of the peritoneum. They kill in much smaller numbers when two or three different organisms are combined than when inoculated in pure culture. The Welch bacillus is no more active in this synergistic action than the other two.

Weinberg, Prevot, Davesne and Renard[31] made a study of 160 acutely inflamed appendices. Anaerobic bacteria predominated in the gangrenous ones. Welch bacilli were presented in 33 per cent of the 160 cases and an anaerobic coccus was present in varying numbers of the entire series.

The work of Ellis and Dragstedt[7] is interesting. They showed that death was produced by placing small pieces of dog liver in the peritoneal cavity of dogs. Gram-negative anaerobic bacteria were recovered from the peritoneal cavity of these dogs. They found that if liver tissue from puppies removed by cesarean section was placed in the peritoneal cavity of adult dogs, no ill effects were noted, and cultures from the peritoneal cavity of this group were sterile. This raises the question of the origin of the Gram-negative organisms in their first group of dogs. They believed that the Welch bacillus is a normal inhabitant of the dog's liver. Search of the literature fails to show any instance in which human liver was used in a similar experiment.

David and Loring[5] produced peritonitis by introducing twenty-four cultures of a mixture of colon bacilli, streptococci and staphylococci into the peritoneal cavity of dogs. Seventeen of twenty-three dogs used in the experiment died within twelve to thirty-six hours. Postmortem examination revealed that an extensive peritonitis was present with a hemorrhagic exudate, which when cultured showed the presence of Welch bacilli in sixteen of the seventeen dogs examined.

Meleney, Harvey and Jern[21] found that in cases of perforated appendices with diffuse peritonitis Welch bacilli were present in 27 per cent, streptococci in 55 per cent and colon bacilli in 100 per cent. In acute non-perforative appendicitis with local peritonitis Welch bacilli were present in 15 per cent, in acute diffuse peritonitis without perforation of the appendix 31 per cent, and in appendiceal abscesses 44 per cent. In all of these cases colon bacilli and streptococci were present in varying percentages.

Copher, Stone and Hildreth[3] conducted a study to show the effect of Welch bacillus antitoxin in controlling peritonitis. They produced peritonitis in twenty-eight dogs by ligating the appendix and the meso-appendix at their bases. In fourteen of the dogs no antitoxin was used. In the fourteen, in which antitoxin was used, 1.7 cc. per kilogram body weight was the initial dose. This was followed by daily intramuscular doses of .5 to 1 cc. of antitoxin per kilogram body weight. Those treated lived an average of 5.3 days. Those untreated lived an average of 4.2 days. Postmortem examinations proved that the treated animals had developed a grade of peritonitis just as severe as the untreated ones. These results can only be taken to imply that the Welch bacillus antitoxin was effective only in prolonging the life of the animals by one day and did not in any instance prevent death.

McIver, White and Lawson[19] produced intestinal obstruction in cats and found that Welch bacilli were present in the loops of obstructed bowel. Antitoxin failed to reduce the mortality rate, showing that the Welch bacillus is not an important factor in the morbidity of intestinal obstruction.

Human feces are a source of Welch bacilli, as shown by Dudgion[6] who found by careful anaerobic methods that in 200 specimens of human feces Welch bacilli were present in 33 per cent. He also stated that in acute intestinal obstruction, and vomiting accompanying advanced peritonitis, the vomitus contained Welch bacilli in most instances.

TABLE I

	Animals Protected with Hydrogen Peroxide				Animals Unprotected with Hydrogen Peroxide			
Experiment no.	6	7	8	9	6	7	8	9
	*	*	†	‡	*	*	†	‡
No. animals inoculated	10	7	5	5	10	7	5	5
No. animals showing distention	10	7	5	5	10	7	0	0
Percentage	100	100	100	100	100	100	0	0
No. animals showing evidence of peritonitis	10	7	0	0	9	7	1	0
Percentage	100	100	0	0	90	100	20	0
No. animals succumbing	5	2	0	0	9	4	1	1
Percentage	50	29	0	0	90	57	20	20
No. animals surviving	5	5	5	5	1	3	4	4
Percentage	50	71	100	100	10	42	80	80
No. animals with post-mortem evidence of peritonitis	5	2	0	0	9	4	0	0
Percentage	50	29	0	0	90	47	0	0
No. animals posted that showed gas in peritoneum	0	0	0	0	0	0	0	0
Percentage	0	0	0	0	0	0	0	0

Code: * Fecal suspension   } Materials used for
     † Anaerobic streptococci } inoculation of the
     ‡ Welch bacilli   } peritoneum.

There is evidence to show that other anaerobes inhabit the human intestinal tract. Arnold H. Eggerth, of the Department of Bacteriology of Long Island College of Medicine, was able to isolate 130 strains of Gram-positive, non-spore bearing bacilli from human feces. Some of these are pathogenic: (1) Bacteroides aerofaciens, which produces abscesses when injected into the subcutaneous tissues of rabbits. The abscesses heal promptly when incised. If not incised, they are slow in healing. The organisms are numerous in the pus, appearing as single slender bacilli or as shorter diplo-bacilli. (2) Bacteroides biformans likewise produces abscesses when injected into the subcutaneous tissues of rabbits. The organisms are numerous in the pus, appearing as coccoid forms in pairs and in chains. (3) Bacteroides pseudo-ramosis is not pathogenic for white mice or guinea pigs. When these organisms were injected subcutaneously into rabbits abscesses developed, which when incised and drained eventually healed completely. These organisms appear in the pus in large numbers as small cocco-bacilli, single or in pairs. They are considered a common contaminant in the air of biological laboratories.

Weiss and Rettger,[32] of the Department of Bacteriology of Yale University, isolated eighty-seven strains of a Gram-negative organism from human stools which were non-spore bearing. Not any of the organisms were considered pathogenic. Very little work has been done by other workers on this group of organisms. It may be possible that the bacteroides are of importance as contributors to the symbiotic existence of other organisms usually reported to be present in peritoneal exudates and abscesses.

The large majority of bacteria obtain their oxygen directly from the atmosphere in the form of free oxygen. For many microorganisms, moreover, the presence of it is a necessary condition for growth. These are spoken of as "obligatory aerobes." Among the pathogenic bacteria many, like the gonococcus, Bacillus influenzae and the Bacillus pestis, show a marked preference for a well oxygenated environment. The condition existing within the infected animal organism cause it to seem likely that all incidents of infection may at times thrive in the complete absence of free oxygen. There is another class of organism known as "obligatory anaerobes" whose development depends upon the absence of oxygen. They obtain their supply of

oxygen indirectly by enzymatic processes of fermentative and proteolytic cleavage from carbohydrates and proteins, or from reduction of reducible bodies. This class is chiefly represented by the tetanus bacillus, the bacillus of malignant edema, the bacillus of symptomatic anthrax, Welch bacillus and the Bacillus botulinus. Intermediate between these two classes is a large group of bacteria which thrive well both under aerobic and anaerobic conditions. Some of these, which have a preference for free oxygen but nevertheless possess the power of thriving under anaerobic conditions, are spoken of as "facultative anaerobes." Staphylococcus, streptococcus, and colon bacilli are among the organisms found in the exudates of peritonitis. They are classed as "facultative anaerobes." Cultures in medium of "deep tubes" and cultures under various gaseous mixtures give abundant evidence of the wide range and selective requirements of bacteria in relation to gradation of oxygen tension.[33]

While a profuse supply of oxygen absolutely inhibits the growth of most anaerobes, a number of these nevertheless develop only when small quantities are present. Minute quantities of free oxygen in culture media do not inhibit the growth of tetanus bacilli. Theobald Smith[26] demonstrated that when suitable nutritive material in the form of fresh liver tissue was added to bouillon a number of anaerobic bacteria may be induced to grow in indifferently anaerobic environment. Ferran[9] succeeded in adapting the tetanus bacillus to an aerobic environment. In so doing, however, the virulence of the bacillus was lost.

Appreciating the multiplicity of environment under which bacteria may grow and the undoubted presence of anaerobes in the exudate of peritonitis, both "obligatory" and "facultative," it seemed reasonable to believe that the introduction of oxygen into the peritoneal cavity of animals with peritonitis may prove beneficial. McGlinn, as quoted by Arthur Stein,[27] was the first to treat tuberculous peritonitis by the use of oxygen and laparotomy. Stein claimed to be the first to treat the disease with oxygen insufflation alone. Search of the literature fails to reveal any reports of experimental work showing the effect of oxygen therapy in cases of secondary peritonitis.

It is the object of this thesis to determine the best method of introducing oxygen into the peritoneal cavity of guinea pigs, and the dosage that could safely be used, in the form of oxygen liberating substances. Guinea pigs were selected because of their low resistance to peritonitis. Oxygen in the free state was not used because of the difficulty in handling and also because clinical usage has determined its safety as used in treating tuberculous peritonitis and as used in roentgen diagnosis. It was further agreed that whatever substance proved safe as a source of oxygen would give the information desired, the effect in treating peritonitis due in part, at least, to anaerobic bacteria.

PLAN OF STUDY AND METHODS

A. To determine the effects on the normal peritoneum of guinea pigs and the toxic effects of certain oxygen liberating substances, namely, sodium perborate, zinc peroxide and hydrogen peroxide.

B. To determine the safe intraperitoneal dosage of these three substances by experimental work on guinea pigs.

C. After these preliminary studies to produce peritonitis in guinea pigs by inoculation with human feces, to study the effect on the disease by introducing oxygen liberating substances directly into the peritoneal cavity.

D. To attempt to produce peritonitis in guinea pigs by inoculation with anaerobic streptococci in one group and with Welch bacilli in another, and study the effect of introducing oxygen liberating substances directly into the peritoneal cavity of these animals.

Experiment 1. Healthy guinea pigs that averaged 500 Gm. in weight were selected.

Under ether anesthesia and aseptic technic celiotomy was done and 500 mg. of fresh sodium perborate were deposited in the peritoneal cavity. The wounds were closed tightly with cotton sutures. This large dose was used to produce the maximum effect and it was expected to be lethal. In approximately eight hours the animals were dead. Marked distention of the abdomen was noted in all animals.

Postmortem examination was made on all animals and the effects noted were uniform. There were present about 15 cc. of serosanguineous fluid which microscopically showed the presence of many red corpuscles but very few white corpuscles. The peritoneum was markedly reddened everywhere. The omentum was found to be greatly injected. Four animals were used in this experiment.

Experiment II. In this experiment the same procedure was followed as in the first, but instead of using 500 mg. of sodium perborate, only 100 mg. were used. Four animals were used and not in any of the animals was an ill effect noted. All showed abdominal distention. Their wounds healed per primam.

Experiment III. This experiment was conducted in the same manner as the two previous ones, except that instead of using sodium perborate, 500 mg. of zinc peroxide were used. The same effects were noted in these animals as in Experiment I, except that the animals survived an average of twelve hours instead of eight hours. The peritoneal findings were essentially the same and no plastic exudate was seen. Four animals were used.

Experiment IV. In this experiment the same procedure was followed as in the three previous ones except that 100 mg. of zinc peroxide were used. All of these animals survived and their wounds healed per primam, and the animals were allowed to live.

In all of the above experiments it was particularly noticeable that within one to two hours the abdomens of all the animals were markedly distended.

Experiment V. In this experiment five animals were selected. Instead of doing celiotomy and depositing a powdered substance into the peritoneal cavity, a different substance was used. In these animals hydrogen peroxide was injected into their peritoneal cavities with syringe and needle. First, 1 cc. of hydrogen peroxide was injected into animal number one. An additional cc. was injected into each succeeding animal until the fifth animal had received 5 cc. of hydrogen peroxide. Not any of these animals died. Marked abdominal distention was present within twenty minutes after the injection. It was particularly noticeable how irritating the substance was to the peritoneum. Violent contortions of the animals began before the injection was completed. This reaction was not prolonged and did not last more than a minute or two. One of these animals developed a paralysis of one hind leg and it was believed that a gas embolus had resulted. It was observed that the abdominal distention in these animals lasted for a period of about two hours. In the animals which had ether an accurate estimate of the continuance of distention could not be made because of the associated anesthetic distention common to celiotomy. The animals receiving hydrogen peroxide injections were not anesthetized so that the amount of reaction could be observed. Several of the animals in the first four experiments became too lightly anesthetized. In these, it was noticed that when the powdered substances came in contact with the peritoneum, the animal showed evidence of pain by reacting with active muscular movements.

By these preliminary experiments it was shown that the above named substances could be used with relative safety in the next experiments. Since the presence of gaseous oxygen in the peritoneal cavity was desired, it was thought that it would be expedient to use the simplest substance that would liberate oxygen. This substance, hydrogen peroxide, had been shown previously to produce abdominal distention in a

very short time, and was quite safe. On the other hand, if celiotomy were to have been done in the following experiments, the other two substances would have been more expedient.

Experiment VI.   Since it had been shown by a review of the literature that anaerobic organisms were present in the exudate of peritonitis of intestinal origin in good proportion to other organisms which may be "facultative anaerobes," it was thought best to start with fecal peritonitis and see what effect oxygen would have in preventing and controlling this type of peritonitis. Twenty healthy animals that averaged 500 Gm. in weight were used.

Stool specimens from forty-six patients were collected and placed in normal saline solution and kept at optimal temperature during the collection period of about eighteen hours. This was believed to be a means of obtaining a medium which would contain all of the organisms that would normally inhabit the gastrointestinal tract. Not any of the patients were known to have dysentery or amebiasis. The suspension was strained and ½ cc. of the material was then injected into the peritoneal cavity of each animal. In ten of the animals nothing further was done, while in the other ten, 5 cc. of 3 per cent commercial hydrogen peroxide were injected into their peritoneal cavities. Six hours later these same animals received an additional 5 cc. of hydrogen peroxide. All animals seemed to be about normal at this time. At the end of eight hours all of the animals except one appeared to be quite ill. Pressure on their abdomens caused them to wince and cry out. Evidently they all developed a certain grade of peritonitis except one. At the end of twelve hours nine of the animals, which had only fecal suspension injected into their peritoneal cavities, were dead. Five of those which had hydrogen peroxide injected were dead. The other seven animals survived. Postmortem examination of those that died showed that they had a violent peritonitis. All showed that the peritoneum was markedly reddened. A plastic exudate was found in all animals with a tendency for greater collection in the upper abdomen, especially under the liver. This finding coincided with the report of Steinburg and Martin[28] who reported on the diffusion of peritonitis with a tendency for greater collection of exudate at the original site and in the upper abdomen. He attributed this to the sucking action of the diaphragm.

Experiment VII.   Believing that the above experiment was not a fair comparison with peritoneal soiling as may accompany intestinal operations in which no gross spilling is apt to occur, it was decided to dilute the suspension four to one and use the same volume so as to provide for the same chance of diffusion but with fewer bacteria. It is to be remembered that the proportion of peritoneal surface in the guinea pig and that of a human being is about 1:140, based on weight.

Fourteen animals averaging 500 Gm. in weight were selected. Into each of the fourteen animals ½ cc. of the diluted suspension was injected. In seven of these animals 5 cc. of hydrogen peroxide were also injected. At the end of nine hours one of the animals injected with fecal suspension and hydrogen peroxide was dead. At the end of twenty-four hours another of this group was dead, and three of those in which only fecal suspension was injected were dead. At the end of thirty-six hours another of the group which had only fecal suspension injected was dead. The remaining animals were at this time lively and wanting food. The postmortem findings in this experiment corresponded to those of Experiment VI. In this experiment, although two of the animals injected with hydrogen peroxide had died, it was noted that the entire group as a whole never seemed as ill as those in experiment six. The animals in experiment seven had only one injection of hydrogen peroxide whereas those in number six had two injections.

Experiment VIII.   To compare with the previous experiments it was believed that an attempt should be made to produce

peritonitis with anaerobic streptococci in pure culture. A pure culture was obtained from the Bacteriology Department of the Bowman Gray School of Medicine. This was diluted with normal saline solution until the suspension showed a count of approximately thirty-two billion bacteria per cc. One cc. of this suspension was injected into the peritoneal cavity of ten healthy guinea pigs weighing approximately 500 Gm. each. In five of the animals 5 cc. of hydrogen peroxide were injected in addition. Three days after the injection of the material one unprotected animal had died. Not any of the others had appeared ill at any time. It appeared from these results that the dilution must have been too great or the virulence of the organism too low to produce peritonitis. The exudate from the dead animal's peritoneal cavity was subsequently injected into another animal. One-fourth of a cc. of fluid was all that could be obtained. This animal died within twelve hours and postmortem examination showed very little evidence of peritonitis and still very little exudate. That which was present was again injected into a third animal. At the end of eight hours the animal was quite ill. Pressure on its abdomen caused it to wince and cry out. At this time 5 cc. of hydrogen peroxide were injected into its peritoneal cavity. Within another six hours another 5 cc. of hydrogen peroxide were injected. Evidence of improvement was very marked. Within another eight hours the animal was up and feeding though still quite ill. Complete recovery resulted. The virulence of the organism was evidently increased by transmission through other animals. No doubt more animals would have developed peritonitis in the first group had the dilution been less. That the organism did produce death in three animals indicates its ability to produce peritonitis and death in guinea pigs. Death of the first animal after three days could hardly be attributed to the toxin of the initial injection alone.

Experiment ix. In this experiment ten healthy animals, which weighed approxi-

mately 500 Gm. each, were used. A pure twenty-four hour culture of Welch bacilli, grown on cooked meat media, was obtained from the Bacteriology Department of the Bowman Gray School of Medicine. One-fourth cc. of undiluted suspension was injected into the peritoneal cavity of each animal. In five of the animals 5 cc. of hydrogen peroxide were injected in addition. At the end of twelve hours one of the animals which had not had hydrogen peroxide injected was dead. Not any of the animals in either group displayed any evidence of peritonitis at any time. Tenderness was not present in any of the animals. A postmortem examination was made on the dead animal and there was no visible evidence of peritonitis. No exudate could be seen. Death was attributed to toxemia. No gas could be detected in the peritoneal cavity. The intestines were neither collapsed nor distended beyond normal. It was difficult to say that peritonitis existed.

COMMENTS

Analysis of the literature on the subject of peritonitis leads one to believe that cases of anaerobic peritonitis have occurred. Not any of the so-called cases reported were cases in which cultures showed anaerobic organisms to be the sole cause. Many of the so-called cases of "gas peritonitis" have been reported, but the mere presence of gas in the peritoneal cavity is not sufficient evidence of a pure anaerobic peritonitis; other organisms can produce gas and yet are not anaerobic, strictly speaking. Lohr, writing in 1929, believed that "gas peritonitis" was a distinct entity. However, in his report in 1933 he had changed his views after experimental work and stated that anaerobic peritonitis does not exist.

All of the experimental work in which peritonitis was produced by ligation of the appendix or in which liver tissue was placed in the peritoneal cavity indicates that tissue necrosis is essential for the growth of the Welch bacillus. There is no record of work which proves this to be true for the anaero-

bic streptococcus. The literature reviewed points toward the fact that several organisms grow best in symbiosis with each other in peritoneal infections. It is unreasonable to think that a single anaerobic organism would be present in the exudate of secondary peritonitis of intestinal origin. It is more reasonable to believe that cases of anaerobic infection of the abdominal wall might afford an entrance to the peritoneal cavity and thereby permit an accumulation of gas in the cavity without this origin being the seat of primary infection.

The results obtained in the use of hydrogen peroxide in treating fecal peritonitis, in the present study, compare favorably with results obtained by Rosenburg and Wall[25] who recently reported on the use of sulfonamides in treating rats in which peritoneal infections were produced. Peritonitis exudate was injected into twenty-one rats, and at the same time sulfanilamide was injected. Eleven of the rats survived. This is less than 50 per cent. Reference to table one shows about the same results with hydrogen peroxide.

Evidently control of the anaerobes, both "obligatory" and "facultative," reduces the mortality of fecal peritonitis, which cases must be looked upon as being partially due to anaerobic bacteria. To state from these experiments that anaerobic peritonitis does not exist is not possible, but it can be stated that anaerobic peritonitis due to a single anaerobe is very unlikely.

CONCLUSIONS

1. Sodium perborate and zinc peroxide in 100 mg. doses is well tolerated in the peritoneal cavity of guinea pigs.

2. Three per cent commercial hydrogen peroxide is also well tolerated in the peritoneal cavity of guinea pigs in amounts up to 5 cc. repeated two and three times per day.

3. Oxygen, as liberated from hydrogen peroxide, is effective in preventing and controlling fecal peritonitis produced in guinea pigs.

4. Anaerobic non-hemolytic streptococci produced by themselves peritonitis in the guinea pig in 10 per cent of animals used in this work. This 10 per cent was controlled by injections of hydrogen peroxide into the peritoneal cavity.

5. Bacillus Welchi alone failed to produce anything at all in the guinea pig which could be called anaerobic peritonitis, indicating its low pathogenicity in the peritoneum of these animals.

6. Fecal peritonitis produced in a series of animals showed a great tendency for a plastic exudate to accumulate in the upper part of the abdomen in greater amounts than elsewhere.

7. The action of oxygen in reducing the mortality rate in fecal peritonitis is not clearly understood. Further experimental work will need to be done in order to establish the exact manner of its action.

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THE FETAL CIRCULATION IS IDENTICAL WITH THE VENOUS CIRCULATION OF THE ADULT MALE AND FEMALE

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SINCE writers on obstetrics still express themselves, when writing on the fetal circulation, that it is composed of oxygenated or arterial blood when they essentially mean sufficiently oxygenated blood, I find it advisable to show that the fetal circulation during the first three to three and one-half months is arterial or hyperarterial and that it is venous thereafter; that its circulatory apparatus is constituted with appurtenances to carry on a large scale venous circulation, and that near birth and at birth the circulation changes to arterial and venous variety, and that the venous circulation is identical with the venous circulation of the adult male and female.

"Certain structures are necessary to the performance of the fetal circulation, but are of no use after birth. They are as follows: (1) Foramen ovale . . . An opening between the two atria. It furnishes direct communication between them. (2) Ductus arteriosus . . . A blood vessel connecting the pulmonary artery with the aorta. (3) Ductus venosus . . . A blood vessel connecting the umbilical vein and the inferior vena cava. (4) The placenta and the umbilical cord . . . The umbilical cord unites the placenta with the naval of the child. The cord is made up of two arteries and a vein. The arteries are branches of the arterial system of the fetus and carry blood from the fetus to the placenta. The usual distinction between arterial and venous blood cannot be recognized, as the blood of the fetus is never up to the arterial standard of the mother."[1] "The placenta is performing several vital functions of the fetus almost entirely. It is the lungs of the child."[2]

From quotations and from my own observations and views I shall try to show that the circulating blood of the fetus is strongly venous in character with the exception of the first three and one-half to four months of gestation which I choose to call the proliferative or potential stage of the fetal existence. This stage embraces the period between the time of conception and that of actual life. The placenta during that period of fetal existence is of a pink appearance, of a velvety soft consistency; cotyledons are undistinguishable and when broken up its content of blood is of a pink hue, similar to the color of the placental tissue; at times even a hyperarterial blood can be squeezed out therefrom. The blood present is not as abundant as in a mature placenta. The circular sinus is more distinctly and more completely formed than in a mature placenta and contains free blood of a consistency and appearance of arterial oxygenation. Innumerable fine villi, finer and more, numerous than in a mature placenta merge and emerge from its walls. Not infrequently a pink or soft cotyledon is seen amidst a mature greyish-blue or greyish-black placenta, a survival of the fetal proliferative stage with a blood content less venous than the rest of the placenta. I can best illustrate this phase of placental development by quoting my own writing: "The frequent presence of immature tissue resembling in structure and consistency the placenta of about two and one-half to three and one-half months' gestation, e.g. soft texture, low density, non-calcareous, infarct free and of a varying pink hue instead of the usual purple blue or bluish green. It occurs as whole cotyledons or as engrafted parts at the

circumference of any cotyledon, and occasionally at its center."[3] These facts suggest that the fetus, during the stage of proliferation, before metabolic processes are urged upon it or before the presence of so-called life is manifest, is supplied with fuel of blood of a nature arterial or arterial plus. It also shows that some fetuses require more oxygen than others; or that nature in its wise providence supplies additional means of oxygenation, in certain cases, for future needs. As soon as the metabolic need for its wants is established, corresponding to the functional development of the cardiac appurtenances which disappear after birth, the blood develops a carbon dioxide content combined with oxygen and it, as well as the placenta, becomes more or less purple or venous.

Period from End of the Proliferative Stage to Beginning and through Metabolic Stage to End of Labor. Inspection of the retroplacental blood of the mature or near mature placenta shows that the clots are, as a rule, venous in nature mingled with clots of colors arterial, and also free blood combinations of unmixed and partly mixed arterial and venous blood, or either entirely venous or entirely arterial. This arterial blood points to nature's effort to supply an increased amount of oxygen, when necessary, during labor. At the same time I am not unmindful of the fact that the purely arterial blood or at least part of it, undoubtedly comes from the uterine wall after separation of the placenta or from a deep laceration of the cervix before the uterus has contracted, or from both sources, before the delivery of the placenta has taken place. The varying clots and the differing shades of mixed and free venous blood most definitely emanates from the placental cotyledons as a result of breaks in continuity caused by pressure and counterpressure exerted on them during the second and third stages of labor.

After the cord is doubly clamped and cut, remove the distal clamp and let some of the blood flow on the white draping; then remove the clamp from the proximal or

fetal end and repeat the same thing near the first stain and both stains will look identically venous. After the child has visibly breathed a few times and before the blood in the fetal stump has coagulated, remove the clamp again and let some of the blood flow on the draping close to the previous stain, and this last stain will be bright arterial blood.

Further observations on the mature placenta emphasizing the venous nature of the fetal circulation. Cut across a large vein on the fetal surface of the placenta and there will ensue a sudden copious flow of venous blood. Now, cut across a comparatively large artery and a relatively minute quantity of similar or higher grade venous blood will come forth. Also, hold the cord in an upright position and cut away the clamped end. Immediately there will issue a spurt of venous blood. Milk up the blood in the cord, starting at the placental end until all the blood is squeezed out. Instantly the cord spontaneously and visibly refills. Squeeze out all the blood again and again and the same thing will happen. Clamp the umbilical vein at the side of the cord or at its outlet and milk up the cord and you will get a few minute quantities of strongly venous blood from two or occasionally three pinhead arterial openings; and after a few milkings nothing will come forth. Now, unclamp the umbilical vein and milk the cord again. You will again obtain the same quantity and degree of venous blood as before; milk the cord repeatedly and the same degree of venous blood will continue to flow. You will, however, obtain no more blood from the umbilical arteries. These facts indicate that the venous circulation is actively upstream while the arterial is passively downward.

"At caesarian sections, through intact membranes, the baby appears bluish and Eastman's studies show that at birth it is normally cyanotic."[2]

COMMENT

All fetuses delivered as miscarriages and all fetuses during cesarean delivery before

the membranes are ruptured, are cyanotic; which again shows that the fetal circulation before it is in contact with atmosphere is strongly venous. Soon after the membranes have ruptured or immediately after delivery when the fetus is in contact with the atmosphere and its pressure, it quickly becomes less venous even before it has visibly breathed. The difference between intrauterine pressure is so great and the fetal body so yielding that air will be forced into the nostrils and mouth, stimulating the larynx; and through the pores of the skin which is the beginning of cutaneous respiration. This can be borne out by the fact that inspection of the chest and abdomen, just before the first gasp of respiration or the first cry, will show tiny, rapid movements of inspiration and expiration. They are best observed on apneic children. In a normal child, normally born, before the cord is tied and before it has actually breathed, if its abdominothoracic region is placed on the palm of the hand, it will assume a position of hyperextension-rotation, that is, instead of flexion or flexibility it becomes tensely hyperextended and in rotation to right or left through an arc ranging from 180 to 250 degrees. When I had first described this phenomenon[7] I attributed it to the forces of labor imposing, impressing or transmitting a continuation of direction on the fetus to the period immediately postpartum. I now wish to add to this theory that it is also due to reaction of atmospheric pressure and the effects of the same. To a less degree this phenomenon can also be observed when the child is placed with its back on the mother's abdomen. It will be observed that the child's extremities are raised in a tensely rigid position with tendency of the spine to hyperextension. This extension-rotation usually lasts from a quarter to three-quarter minutes, when the child takes a deep gasping breath, relaxes and cries lustily.

Estimates of as high as 50 per cent of oxygenated blood in the umbilical vein as compared with the arterial of 95 per cent[2]

are not a standard, as it is less and still less, as an increased amount of oxygen has already been forced into its circulation and its tissues by the powerful contractions of labor, and has come in contact with atmospheric pressure even while issuing through the vulva and has breathed already partially or completely. These facts influence the estimates as they are invariably done after the child is delivered. The placental and umbilical veins carry slightly oxygenated blood to the fetal heart and tissues and after having given up their oxygen the arteries carry back purely venous or deoxygenated blood. "The fetus in utero is hypotonic if not actually atonic. It lacks well developed mechanism to return its blood to the heart. The uterine musculature substitutes for this lack of tonus and rhythmic prelabor uterine activity assists in returning the blood to the fetal heart."[2] The fetal heart then acts simply as a relay station on the highway of the fetal circulation; it is acted upon purposefully instead of acting on its own initiative. To be more specific, the fetal heart beats not because it circulates blood but because, essentially, blood is circulated through it; or blood is pumped through the fetal heart instead of the heart pumping the blood. "The fetus needs little oxygen as its combustion processes are slow; it moves little and meets with no resistance; it has no perspiration with the evaporation from the skin. It loses no heat."[2]

The change from the natal venous circulation to the postnatal arteriovenous circulation is approximately as follows: The first and most important event is the onset of respiration. The effect on the newborn of the sudden change from intra-abdominal to atmospheric pressure with the resulting respiration I have already mentioned. In the adult the vacuum circulatory system is in close coördination with the respiratory vacuum mechanism where each one is auxiliary to the other and each one is pacemaker or equilibrator to the other. The initial start in that direction is accomplished by the stoppage of the placental

circulation. From this moment on the child has need for more oxygen and hence gets the urge to seek its own oxygen supply. "All the primary readjustments appear to be fairly well accomplished by the end of the first month or six weeks after birth. The lungs are completely inflated, the red cell count and the hemoglobin index are about at adult levels, the lumen of the ductus arteriosus is reduced to almost nothing, and the valvula foraminis ovalis has been pulled tight across the foramen and close against the septum."[4] "Last of all the postnatal changes to be accomplished is the building up of the left ventricular musculature. The factors which initiate the increase in weight and the power of the left ventricular wall becomes operative when the new functional balance is established in the heart with the actual closure of the ductus arteriosus and the functional closure of the foramen ovale."[4]

Nature does not tolerate vacuums and the whole system of circulation and some of its purposes is the tendency to vacuum formation and its prevention. The driving force and highest source of fetal circulation is the maternal heart whose blood is amply accumulated and relayed through the uteroplacental subsidiaries to the fetal heart, and returns by means of the arteries through sheer gravity back to the utero-placenta. This gravitational flow downward creates a tendency to vacuum formation above it, and the tendency to prevent such vacuum formation stimulates an upward venous flow. This process goes on con-tinually. The fact that the source which gives the impetus and power to the fetal circulation, the maternal heart, is higher than the fetus, adds momentum to the fetal circulation. The caliber of the momen-tum is so constituted that it can reverse the direction of the fetal circulation, as in cephalic presentation, with equal facility, in fact with superior facility, as the direc-tion of the circulation is down instead of upward. This is due to the hypotonicity or atonicity of the fetus.

In the adult male and female the gravi-tational downward flow of arterial blood minus resistance of venous-like valves, backed by the siphoning contraction of the heart is powerful enough to stimulate and start the venous circulation upward, assisted by respiration. These facts make the passive venous circulation so rapid, and its audible pulse rate is caused by its hitting the flaps of the venous valves. In the fetus the venous sounds are comple-mented by the action of the atonic heart. The venous circulation of the adult as well as of the fetal heart is of irregularly alter-nating double and single beats.[5] I should attempt to explain this on the assump-tion that the venous valves do permit a certain reflux flow when the quantity needed is super- or subabundant tempora-rily; and this may happen at any moment in any part of the body. Since the fetus is hypotonic or atonic, the same status must apply to the heart which is being acted upon; the same reflux is undoubtedly taking place therefrom. As the oxygen or the oxygen and carbon dioxide supply is not uniform, the same thing applies to the blood supply and there has to be periodic excesses or diminutions of the same and hence there must be regurgitation. The fetal heart is equipped with appurtenances which disappear after birth to enable such regurgitation without the incidence of murmurs. The unstability of the fetal circulation is evidently due to the atonicity of the fetal heart and to the fact that the vasoconstrictor and vasodilator system of control is still absent or undeveloped in the hypo- or atonic fetus.

Although the maternal and fetal cir-culations are in a sense, independent, nevertheless the fetal circulation emanates from the system of the maternal circula-tion. The fetus having origin in adults and being a potential adult, must have its scheme of behavior and its way of life explicitly imposed on it. The larger system of venous circulation than that of the ar-terial which is essential, and which both the adult and fetus alike possess, the more yielding walls of the veins as compared

with the arteries which make them more responsive in resisting vacuum formation, and the fact that the veins have valves preventing undue reflux, and the siphoning action of the heart in the adult are important agencies for the execution of the vacuum based fetal circulation.

As the placenta is the lungs of the fetus, the contractions of the uterus with their actions on the placenta are its oxygen supply as well as the reservoir supply of blood of the uterine and placental sinuses and the multiplicity in numbers and relative largeness of the placental veins. They form a superabundance of oxygenated blood to maintain the fetus in the stage of its vast proliferation activity and later these very channels supply a mixture of oxygen and carbon dioxide sufficient to carry on its limited metabolic processes required for its limited functions.

To facilitate the venous circulation "the villi grow in the direction of the venous openings and away from the arteries, the blood stream naturally swimming then in this direction."[2] The vacuo-aspirating automotive action of the circulation and principally of the fetal circulation is complemented and facilitated by a vermiform action of the uterine musculature not unlike that of the undulating waves of the stomach or the undulation of the scrotum, the latter vividly visible to the naked eye. The arrangements of the muscular layers of the uterus is just suitable for such vermiform action culminating in the painless uterine contractions of the non-gravid and the gravid state and the painful contractions of labor. Since there are periodic contractions of the uterus there has to be preliminary or preparatory steps like the undulating movements, leading up to these climaxes which in turn subside to the various degrees of undulation.

Crux of the Thesis. The adult venous pulsations, identical with that of the fetal heart working through venous channels, can be heard in men and women and youths over parts of the body where its circulation cannot be compressed by the stethoscope.

It is best heard at and on the anterior superior spine of the ilium, the iliac fossa, the lumbosacral region, the symphysis pubis, the coccyx and over the long bones, more so over the lower extremities, also over Poupart's ligaments, fibroid uterus and pregnant uterus, particularly before the fetal heart beats are audible. The venous sounds and rate are typical of the fetal heart with the exception that they are of a lower pitch. It may take a one-quarter to one-half minute for the transition to take place from the slower and higher pitched radial pulse rate to the rapid, irregularly alternating single and double low pitched venous pulsations to be heard. In most instances both the arterial and venous pulse rates can be heard synchronously.[6]

SUMMARY AND CONCLUSION

1. There is a stage of fetal existence, the proliferative stage, before active life has set in, when the fetus is supplied with arterial blood.

2. The estimates of oxygen in the fetal blood is done after delivery when it has acquired additional oxygen through uterine contractions of labor, atmospheric pressure and actual respiration.

3. Because the fetal body and consequently the fetal heart is atonic or hypotonic, and not subject to the vasoconstrictor and vasodilator influence or but slightly so, it does not pump blood but blood is pumped through it.

4. The fetal circulation is initiated, stimulated and carried on by the maternal heart and relayed by way of the uterine contractions, uterine muscle activity, placental circulation and fetal heart.

5. The fetal veins and heart permit reflux of blood without incidence of murmurs.

6. The uterus possesses an undulating mechanism which climaxes into uterine contraction, again receding to undulations.

7. The fetal blood supply may be divided, as far as its oxygen supply is concerned into a triad of (1) proliferation or potential life, with arterial circulation,

(2) venous circulation during active life and (3) combined arterial and venous circulation during the stage of labor to counteract the increased content of carbon dioxide.

8. The source of retroplacental clots and free blood and the cause for the various states of oxygenation are pointed out.

9. A method of eliciting venous circulation in adults is explained.

10. The fetal circulation is largely stimulated by a tendency to vacuum formation and its prevention. In adults the vacuum circulatory mechanism is supplemented by the expiratory tendency to vacuum formation and its prevention and they both form an equation: one is to the other as the other is to the one.

11. The independent circulation in the newborn is initiated by the stoppage of the placental circulation causing an urge in the fetus to seek its own oxygen supply. It finds this urge gratified by atmospheric pressure forcing air into the larynx and through the skin when the fetal body is released from pressure and compression of labor; and together with the change of temperature (higher or lower) they all culminate into the system of respiration.

12. The fetal circulation with its rate about twice that of the mother's is identical with the venous circulation of the adult male and female.

13. While the venous circulation is of a low pitch, the fetal heart sounds, identical with it, are of a more intense nature and of a higher pitch as a result of the additional sounds caused by systole and diastole.

14. The extension-rotation reaction of the fetus to atmospheric pressure is, as a rule, the first visible evidence of extrauterine life. It is also the first instance of extrauterine vacuum presence and the inspiratory tendency to counteract it.

15. The adult heart beats are about one-half the rate of the venous circulation due to the rhythmic action of respiration, increased blood pressure, absence of fetal heart appurtenances, acquisition of muscular size and tonicity of the same, together with the vasoconstrictor and dilator system of control.

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FIVE YEARS' EXPERIENCE WITH SPOOL COTTON AS A SUTURE MATERIAL

ROUTINE USE IN OVER 1,000 OPERATIONS

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IN view of the great amount of time and effort devoted to the development of safer, stronger, sterile, absorbable catgut material, it seems very anticlimactic and undramatic to extoll the virtues of common spool cotton, easily obtainable in varying sizes and all usable lengths, simply sterilized, and most amenable to being tied into knots that hold. A number of reports concerning cotton sutures have been published, and a trend in favor of non-absorbable sutures is in evidence. Nevertheless, many surgeons continue to use catgut sutures routinely, and change over to the classic use of Pagenstecher linen or to silk, disregarding the rather comprehensive experimental and practical work reported favoring the use of cotton thread.

Such experimental and practical tests show the many advantages offered by cotton sutures: (1) Strength of the suture is preserved after sterilization and after it is embedded in tissue; (2) cotton causes minimal tissue reaction without serum accumulation; (3) fibroblasts form earlier than in wounds closed with other suture materials; (4) the natural twist of the cotton fibers maintains a compact suture with little separation of the fibrils and practically no tissue ingrowth, an important factor in infected and contaminated fields; (5) cotton can be obtained in strengths sufficient for routine surgical procedures; (6) cotton is pliable, can be tied in a square, or granny, knot; and (7) cotton is economical.

The author reported experiences after six months' routine use of spool cotton in 150 major surgical procedures,[19] after having learned the technic used by Dr. Alton Oschner. Such experience now extends into the fifth year, and pertains to well over 1,000 operations. Bone surgery is not in-

cluded. Vaginal and rectal operations are also not represented in this series, although cotton has been used in such cases by other surgeons.

Cotton sutures were used in many cases of peritonitis and in contaminated wounds. Draining sinuses were not encountered, such as those seen after the use of non-absorbable sutures of silk and linen. The explanation for this difference lies, in part at least, in the compact suture provided by the natural twist of the cotton fibrils mentioned above. The use of sulfa drugs and cotton sutures ensure excellent results in these contaminated and infected fields of operation.

In the series here reported, cotton sutures were used in intestinal anastomoses (mucous membrane), and between gall-bladder and small bowel. There were no reasons to regret such use. Undoubtedly, such sutures slough into the lumen and are passed. In gastric resections interrupted sutures of quilting cotton are used throughout, except for the through-and-through suture line, for which we use No. 000 plain continuous catgut. This is re-enforced with No. 80 cotton. We find no objection to using absorbable and non-absorbable sutures in the same field. In operations requiring the placing of many sutures, such as thyroidectomies and mammectomies, closure with cotton sutures can be made without drains, and dry healing occurs promptly.

To avoid confusion and to clarify terminology, a listing of kinds of cotton thread with a brief description follows:

Mercerized cotton thread is a thread which is subjected to an immersion in a bath of caustic soda and other chemicals. During the time the thread is immersed in

the chemical bath, it is stretched, and the physical characteristics of the fibers are changed to some extent. In mercerizing, the fibers have a tendency to shrink, causing them to cling together more closely. This increase depends upon the size of the yarn, the number of turns or twists, and the number of plies or ends. However, it is reasonably safe to say that the increase in strength will be 15 per cent or more.

Quilting thread is a cotton thread which has been run through a bath of starch, the purpose being to lay the fiber and to increase the strength somewhat. Any thread which is run through a bath of starch is called a glacé or polished thread. A glacé or polished thread will be approximately 10 per cent stronger than the same thread without starch. In the case of mercerized and polished thread of identically the same construction as regards size, ply, and number of turns, the mercerized thread will always be considerably stronger. Boiling will not adversely affect the tensile strength of either mercerized or plain cotton thread; in fact, an increase as high as 11 per cent is reported after sterilization by boiling; but boiling would materially reduce the strength of a polished thread because it would remove the starch.

Crochet cotton is in many ways similar to a sewing thread, the principal difference being in the number of turns or twists. Crochet cotton comes usually in three-ply or six-cord. Many years ago crochet cotton was almost entirely unmercerized, but in recent years the trend has been to mercerize, so that perhaps 99 per cent of the crochet cotton on the market today is mercerized. The previous statement would also apply here, that is, the mercerized crochet product would be some 15 per cent or more above the equivalent unmercerized items in strength.

Microscopic examination shows that the cotton fiber is twisted. This natural twist, not possessed by silk or linen, keeps the three- or six-cord spun thread from fraying or raveling. This prevents ingrowth of

tissue which would result in draining sinuses.

The major part of the work in my series of operations was done with quilting cotton, and No. 24, single or double. The thread most used for subcutaneous vessels was No. 100 or No. 150. The heaviest for any purpose was crochet cotton No. 10.

To simplify procedures on our service at the Cook County and American Hospitals, No. 24 spool cotton and quilting cotton, either white or black, have been used for everything, including ligating, suturing tissue stumps, vascular pedicles, peritoneal and fascial closure, with no untoward results.

One discovers by experience in autoclaving and in use of cotton thread that there are differences in makes of threads. Only the standard brands should be used, and one learns to select one of the better brands to the exclusion of all others. It is observed that strength varies with different brands and not with the diameter of threads, some fine cottons being as strong as coarse threads of other makes.

Experience with cotton sutures leads one to stress and emphasize the principles of Halsted, in order to obtain good results with non-absorbable sutures; (1) Use interrupted sutures; (2) use suture material as *fine* as possible; (3) cut sutures *very* close to the knot; and (4) avoid leaving dead space.

Once the surgical team becomes thoroughly accustomed to the cotton thread technic, the operating time is not greatly lengthened. Interrupted sutures must be carefully placed. There should be no mass ligations with coarse threads and dead space around the knots. Such errors in technic are responsible for the sloughing of sutures and other difficulties in the use of cotton. The fine sutures are tied so as to coapt tissue properly without strangulation. If the suture threads are broken in tying, unnecessary force has been used. An entire row of sutures are placed before one is tied. All threads may be drawn up at once to approximate the tissues in a smooth line, all knots are tied, and all ends cut.

While catgut swells after it has been placed in the tissues, cotton thread simply maintains the knot as it was tied. Absorption or digestion of the catgut is accompanied by excessive exudation, stretching and weakening of the suture, and slipping of the knot. Cotton thread results in dry healing with early appearance of fibroblasts. When cut close to the knot, its friction is sufficient to hold. Infection is much more apt to occur in the wet healing of catgut as compared with the dry healing with cotton sutures. The chemicals associated with the making of catgut, as well as the protein content, contribute to the inflammatory reaction, a reaction varying in different individuals so that instances are encountered in which twenty-day catgut may be completely absorbed in a half or a third of this number of days. Infection delays healing and increases the speed of absorption due to the substances liberated by the leucocytes with proteolytic action. Cotton holds the suture line until infection can be overcome and healing takes place.

From the standpoint of cost, it may be noted that while catgut for the average appendectomy costs about $1.50, two cents worth of cotton thread will do the job. Cotton may be sterilized just before using, and may be used wet, when its strength is greater. All unused material is discarded, since its cost is negligible.

The patient's stay in the hospital is shortened by the prompt healing of the wound, and the justifiable reliance upon the security of the closure enables the patient to sit up and walk about sooner after operation. This contributes to the patient's morale and general well being, and reduces the risk of postoperative pneumonia and thrombus formation:

This advantage of cotton thread has been dramatized by its use in war surgery where the need for early evacuation from field tents to hospitals farther from the front sometimes requires transportation over rough roads and under other wartime difficulties. Also, under battle conditions, the number of infected or grossly contaminated fields runs high. Sparkman,[17] writing concerning the satisfactory use of cotton sutures in war surgery, also confirms the belief of Meade and Ochsner[14] that nonabsorbable suture material is used advantageously in grossly contaminated wounds. In his series of 237 cases of battle casualties, forty-five required Thiersch grafts, and he reports, "It was the invariable rule that healthy granulation tissue grew over and covered such cotton as was implanted in the wounds, with resultant smooth granulating surfaces which were altogether satisfactory for the application of grafts."

Study of sulfonamide impregnated sutures shows definitely better healing and reduced bacterial growth in contaminated wounds when cotton sutures were used. Catgut impregnated with sulfonamide exerted little or no beneficial influence on bacterial infection or wound healing.[7]

Cannaday[3] prefers a combination of sulfanilamide and sulfathiazole. He reports a series of 612 cases with contaminated wounds operated upon by himself and associates, using cotton thread sutures, sulfanilamide, sulfathiazole, and wound irrigations with saline solution. The sulfanilamide undergoes absorption within forty-eight hours; the sulfathiazole is more slowly absorbed and extends the protection against late infection. He favors the use of both in small amounts, 1 to 3 Gm. on the average, in all wounds, whether contaminated or not, and not over 6 to 8 Gm. in grossly contaminated fields. The crystalline forms are more soluble than the powder or granulated varieties.

We agree with Cannaday, who warns that beginners in the use of cotton thread may occasionally have formation of sinuses, followed by extrusion of cotton thread, due usually to the use of too heavy sutures too near the skin, and to failure to close dead space over these heavy sutures. Heavy ligatures inside the abdominal cavity, such as are used by some surgeons in stomach resections and hysterectomies, may be duplicated with heavy cotton thread. Such

ligatures are quickly glazed over by peritoneum and apparently do not cause trouble later.

The contrast in tissue reaction with non-absorbable sutures as compared with catgut is well illustrated by experiments reported by Farris.[5] Sutures were introduced into the anterior chamber of the rabbit's eye. The effect of catgut, silk, linen and cotton were observed grossly through the transparent cornea. With catgut the aqueous humor became completely opaque in ten days and blindness resulted. Cotton caused a minimal reaction. In some cases the sutures were left in for a year or more, and the reaction in the case of cotton and silk was light, cotton averaging slightly less than silk. It was noted that cotton in contrast to silk showed much less tendency to untwist and fray.

In tests made by Meade and Ochsner, different suture materials were placed in the fascia and muscles of the abdominal wall of rabbits, and removed for testing of the tensile strength after two to fourteen days. The tensile strength of the cotton sutures alone was unimpaired. The catgut showed stretching, as well as the greatest decrease in tensile strength.

Large[11] implanted sutures in the leg muscles of the dog and removed the tissues for microscopic study. There was less reaction about the sutures of cotton and plain spool silk than with catgut, nylin or plastigut.

Word and Brock[21] report using cotton sutures exclusively for two years in some 200 major operations, with uniformly good results, not due alone to the cotton material, they believe, but to the delicacy of technic and more gentle handling of tissues as compared with catgut routines. With such delicate technic, postoperative pain is lessened. Similar conclusions are drawn by Stokes and Mejia.[18] They report complete absence of liquefaction, and note the smooth, painless, pliable nature of resultant scars. The relative fragility of the sutures prevents any rough tying and consequent strangulation of tissues. As a result the patient's postoperative febrile response is very mild.

Loomis[13] reports the use of double strands of No. 10 crochet cotton, previously wet, and tied with a double knot to join fragments of the patella after simple transverse fracture. Quilting cotton was used for the articular capsule and No. 80 for the ligation of bleeding points. There was a minimum of joint effusion and local reaction. He states that cotton maintains its tensile strength 100 per cent at the tenth day of wound healing.

A very comprehensive report giving comparative data on various types of sutures speaks of the percentage of *loss* of tensile strength of cotton sutures in the process of sterilization, but it is also stated that the cotton was wound on "machine bobbins." It is now well known that cotton shrinks in the process, and must be wound on rubber tubing or a core that will allow the thread to shrink without tearing or loosening the fibrils. If this procedure is followed, the tensile strength is increased and the firmness of the twist maintained during the sterilization.

Much discussion has been given the subject of individual reaction to catgut, revealed by unusually rapid digestion and absorption of the sutures. An instance is reported by Henry[9] of complete evisceration on the fifth day following an abdominal hysterectomy in which forty-day chromic catgut was used for closure. Only a small strand of frayed and digested gut remained in the wound. The patient was young and well nourished. A previous operation, thyroidectomy, had healed quickly with non-absorbable sutures. A sensitivity to catgut was evidenced in this case, so that the phenomenon was thought to be one of allergy. Normal healing occurred after reclosure of the wound without the use of catgut. Two recent comprehensive studies on catgut have been made, Hopps[10] and Pickerell and Clay,[16] in which animals were sensitized to sheep serum and similar materials, but catgut sutures embedded in these animals were not digested with

undue rapidity. In these studies the conclusion was reached that allergy was not the explanation for this phenomenon. Regardless of the conclusions to be drawn, the important fact is that the distressing circumstances attendant upon partial or complete disruption of surgical wounds and eviscerations may be lessened by the use of cotton sutures.

CONCLUSIONS

1. Cotton remains, the suture material of choice after five years experience with it, in over 1,000 cases.

2. It makes for finer technic and less tissue trauma.

3. Evisceration, infection and draining sinuses are less likely to occur with cotton sutures.

4. It is safer to get patients out of bed early with this suture material, thus lessening postoperative thrombus formation and pulmonary complications.

5. Cotton is economical, easy to sterilize and standardize.

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UNUSUAL TUMORS OF THE STOMACH*

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WE wish to emphasize the importance of considering the less common tumors of the stomach in any differential diagnosis involving a large intra-abdominal mass. These observations are based upon a study of the literature and upon three cases which underwent surgical operation in our clinic. The cases include two leiomyomas and one hemangioendothelioma.

Although non-carcinomatous tumors represent roughly a quarter of all gastric neoplasms, they remain a clinical rarity since the vast majority do not present symptoms and are accidentally discovered at autopsy. Rigler and Erickson, basing their conclusions on 6,742 autopsies, reported that benign tumors comprised 26 per cent of gastric neoplasms.[1] Leiomyomas are seen most often, comprising 36 to 60 per cent of the benign tumors, with gastric polyps next most frequent (19 per cent according to Minnes and Geschicter).

The most common gastric tumors are adenocarcinomas. Various authors estimate sarcomas as occurring from 1 to 8 per cent in relationship to carcinomas. Most of these are not large. A clinician confronted with a large intra-abdominal mass must consider leiomyomas and sarcomas of the stomach in his differential diagnosis.

The benignancy or malignancy of such a tumor is difficult to decide, even in a microscopic study and the correct clinical evaluation is often impossible. Lamon and Broders insist upon the reliability of mitotic figures as evidence of malignancy in this type of neoplasm,[3] yet Melnick reports a smooth muscle tumor of the stomach with apparent metastasis to the liver which he interpreted as benign in his microscopic report, the tumor having met his definition of benignancy in that the cells of the primary growth and the metastasis were fully differentiated and mature, showed no anaplasia, had few mitotic figures and showed an expansive and not an invasive growth.[4]

Since leiomyomas are the most common non-malignant tumors we wish to describe their characteristics in some detail. Leiomyomas give symptoms according to:

1. *Size.* The tumor mass may be the only complaint and finding.

2. *Location.* The bulk of the tumor may carry with it either the mucosa or the serosa of the stomach, since the lesion originates in the muscularis, and may therefore be intragastric or extragastric. The extragastric tumor presents a diagnostic problem in that its origin may be uncertain. In one of our cases the tumor was first palpated during pelvic examination and was thought to be a fibromyoma of the uterus or an ovarian cyst (Case 1). The most prominent symptoms of the intragastric tumor may be those due to pyloric obstruction or dyspepsia from the presence of the mass within the stomach.

3. *Ulceration.* If leiomyoma is intragastric, ulceration of the overlying mucosa frequently takes place with resultant hemorrhage and melena. This occurred in the intragastric leiomyoma we are presenting (Case 11).

4. *Malignant Change.* There may be metastasis to the liver and, according to Golden and Stout,[5] rarely to the peritoneum and lungs. Mass and Kirschbaum[6] report a case of metastasizing leiomyosarcoma of

the gastric fundus, with perforation and death due to peritonitis.

Of the malignant tumors of the stomach,
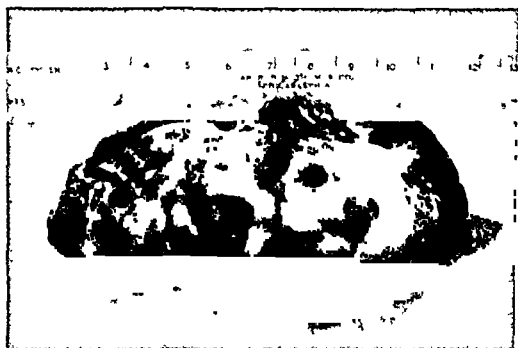
FIG. 1. Case 1. Leiomyoma of stomach, gross specimen.

other than carcinoma, lymphosarcomas represent between 60 and 70 per cent; fibrosarcomas, myosarcomas and hemangioendotheliomas or angiosarcomas make up the remainder.

Hemangioendotheliomas are those tumors which apparently arise from the endothelium of the blood vessels. They are composed in large part of clear cells resembling endothelial cells. If these tumors are malignant, the nuclei are hyperchromatic and may show mitotic figures. The architecture follows a pattern in which blood spaces are prominent. (Fig. 8.) Between the spaces, sheets of endothelial type of cells may form an indistinct stroma. When enotheliomas metastasize they may spread to adjacent lymph nodes as well as through the blood stream. In Case 11 the presence of two apparently independent hemangioendotheliomas in the same patient is most unusual.

Although, as has been stated, the presence of malignancy in a leiomyoma is difficult to determine, it may be possible to distinguish between carcinoma and sarcoma and, according to Mallory and others, between lymphosarcoma and the less common forms of sarcoma, by means of x-ray study.[7] The latter point of distinction is a fine one and yet important since lymphosarcoma is the only one of the tumors which is not susceptible to operative attack.

Carter and Laing[8] give the roentgenological signs of non-malignant tumors of the stomach, but insist that, these criteria being met, the lesion may only be suspected of being non-malignant. They state that "a sharply circumscribed, rounded, endogastric mass, bearing a demonstrable ulcerative niche, may be considered prob-

FIG. 2. Case 1. Leiomyoma. Microscopic section reveals cells resembling smooth muscle with areas of degeneration. × 50.

ably a radio-resistant non-lymphatic sarcoma. Such lesions without a niche and not too large may be considered presumably, but only presumably, benign." These authors further state that a lymphosarcoma should be considered if the intragastric mass shows irregularity. They suggest a therapeutic test in such cases by irradiation therapy.

A further roentgenological point in differentiating benign from malignant gastric lesions is given by Moore[9] who says that the gastric rugae in the neighborhood of benign lesions are relatively undisturbed as contrasted with the obliteration of rugae surrounding malignancies.

Treatment of non-carcinomatous gastric tumors, except lymphosarcoma, is surgical, regardless of symptoms and, as it may be seen, the lesions are often asymptomatic. Eusterman and Senty[10] classify benign gastric tumors as primary and secondary. Primary tumors are those in which surgery is performed because of the tumor itself. Secondary tumors are those found accidentally in the course of operation for something else. It is conceivable that in the clinical work-up to which a patient may be subjected in the investigation of an obscure complaint, non-carcinomatous tumors of the stomach may be found either as a primary cause for that complaint or as a secondary incidental finding. In view of the uncertainty as to course and as to malignancy, laparotomy is indicated in all cases.

The type of surgery depends upon the degree of involvement of the stomach. Lahey and Colcock[1] advocate high subtotal gastrectomy, regardless of the location of the tumor and total gastrectomy if the entire stomach is involved. Walters[11] suggests local excision if frozen section shows no malignant cells.

CASE REPORTS

CASE I. Mrs. O. F., a housewife, aged fifty-seven, came to the Clinic complaining of "heart burn" which had been present at intervals for one year. At times this dyspepsia was relieved by soda. Stooping seemed to aggravate the discomfort. Most of the time when the patient was not having dyspepsia she had a sensation of a "rock" in the stomach.

The general physical examination was uninformative. The patient was edentulous and wore dentures. The heart sounds were normal and the rhythm was regular. There was tenderness on palpation of the epigastrium and along the right costal margin. Examination of the

pelvis revealed a cystocele, with the uterus in the upright position. Her blood pressure was 160/90; pulse 80; temperature 98.6°F.

FIG. 3. Case II. Roentgenogram revealing a filling defect of stomach caused by a leiomyoma.
FIG. 4. Case II. Gross specimen resected portion of stomach showing the intragastric leiomyoma with ulcer on surface.
FIG. 5. Case II. Leiomyoma. Microscopic section reveals cells resembling smooth muscle cells with no mitotic figures found. × 40.

Roentgenological examination revealed a poorly functioning gallbladder, right hydronephrosis and right hydroureter with a stricture near the bladder. The gastrointestinal series revealed nothing abnormal.

Laboratory data was as follows: Urine—specific gravity 1022, acid, trace of bile; hemoglobin 84 per cent; erythrocytes 4.08 million; leucocytes 6150; differential count:

polymorphonuclear 67 per cent; lymphocytes 33 per cent; gastric acidity 57 total, 35 free; Kline test negative.
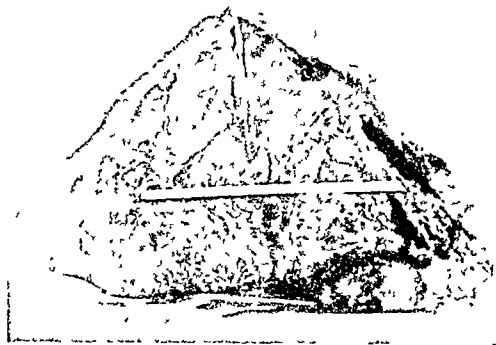
FIG. 6. Case III. Gross specimen of hemangio-endothelioma of stomach. The tumor is cut open showing areas of hemorrhage, cystic degeneration and necrosis. The ruler is 15 cm. long.

A tentative diagnosis was made of stricture of the right ureter with hydronephrosis and hydroureter, and poorly functioning gall-bladder. The stricture of the ureter was dilated and medical management instituted for the poorly functioning gallbladder.

The patient continued to be uncomfortable and to complain of dyspepsia and a sensation of a "rock" in her epigastrium.

Approximately one year later the patient was suddenly taken ill with severe pain in the pelvis. A pelvic examination revealed a movable fist-sized tumor in the right side of the pelvis. A diagnosis was made of ovarian cyst or fibromyoma of the uterus. A laparotomy was advised and the patient accepted.

Operation was done two days later at the Wells County Hospital under ethylene anes-thesia. Because the tumor was apparently of pelvic origin a low midline incision was made. When the peritoneal cavity was opened no pelvic tumor was found but there was a tumor arising from the greater curvature of the stomach near the pylorus. This tumor had prolapsed together with the stomach, into the pelvis and had been felt there during the previous pelvic examination.

The tumor measured 10 by 7.5 by 4.5 cm., was smooth and glistening and red to yellow in color. (Fig. 1.) The omentum and the transverse colon were attached to the tumor by large vascular pedicles which had to be carefully ligated before division. When the tumor was finally freed it was found to be attached to the greater curvature of the stom-ach by a pedicle 2 cm. in diameter. The tumor apparently did not involve the muscosa. A buttonhole of stomach wall 3 to 4 cm. in diameter was removed with the neoplasm. The opening in the stomach was closed with No. 0 plain and chromic catgut sutures on an atraumatic needle. There was no pathologic condition found in the gallbladder. The wound was closed in the usual fashion with No. 2 plain catgut in the peritoneum and No. 2 chromic in the fascia and dermal in the skin.

The postoperative convalescence was un-eventful and the patient was able to leave the hospital two weeks after laparotomy.

Microscopic examination of the tumor re-vealed leiomyoma with areas of degeneration. (Fig. 2.) The sections of the tumor were examined by Dr. A. C. Broders[12] as follows: "I am of the opinion that the sections show a degenerating leiomyoma. Leiomyomas of the stomach rarely undergo a sarcomatous trans-formation, but are prone to degenerate."

Nine years later there is no evidence of recurrence and the patient is alive and in fair health for her age.

CASE II. Mr. J. M. C., a sixty-three-year-old carpenter, was admitted to the Clinic January 27, 1942, complaining of mid-epigastric burning, "heart burn," and two recent episodes of tarry stools. There was also a history of three hemorrhages from the mouth in a two-day period a year before admission, at which time three transfusions of whole blood were given. The symptoms of indigestion had been present for ten years and he had indifferently followed an ulcer diet. There had been dizziness and occasional episodes of aching beneath the right shoulder blade.

Physical examination revealed a well pre-served elderly man with few positive findings except moderate tenderness on deep palpation over the mid-epigastrium. His blood pressure was 132/84, pulse 80; temperature 98.0°F.

Blood analysis disclosed a red blood count of 4.54 million with a hemoglobin of 79 per cent; Mazzini test negative; urinalysis nega-tive; gastric analysis revealed free acid 36 and total acid 51.

Gastrointestinal series revealed a defect 3.5 cm. in diameter on the greater curvature of the stomach. This had a smooth outline and there was moderate tenderness on palpation over it. One-hour stasis study showed a 25

per cent residue in the stomach with the same deformity present. Five-hour stasis study revealed only traces of barium in the stomach

and the part protruding into the stomach lumen measured 5 by 4 by 4 cm. A cystic hemorrhagic area projecting into the lesser
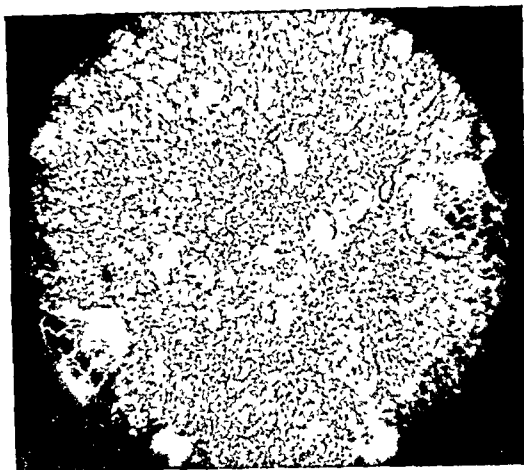
FIG. 7. Case III. Hemangio-endothelioma. Microscopic section reveals many large round or oval cells which tend to arrange themselves in vessel-like spaces. Some of these contain blood. × 50.

FIG. 8. Case III. Hemangio-endothelioma of the liver found at necropsy. This tumor is composed of blood spaces and many sarcoma-like cells. The stroma is more dense and the cells more closely packed than in the tumor removed from the stomach at operation. × 40.

surrounding the mass on the greater curvature. (Fig. 3.) Roentgenologic diagnosis was myoma of the stomach. Immediate surgery was advised.

The patient entered the Clinic Hospital on February 9, 1942. Roentgenologic study on this date confirmed all earlier findings.

Laparotomy was performed February 12, 1942. Under cyclopropane anesthesia, a paramedial incision was made in the right upper quadrant. The tumor was found within the wall of the stomach on the greater curvature. It was about one-third intragastric and two-thirds extragastric, extending into the lesser peritoneal sac. In the latter area it was somewhat adherent to the peritoneum. A Polya type gastric resection was done removing about 15 to 20 cm. of stomach extending upward from the pylorus, and the wound closed. During the operative procedure 1,000 cc. of plasma was administered by vein.

The patient's postoperative course was uneventful and he was dismissed February 25, 1942.

The gross specimen consisted of 15 cm. of the stomach. The growth involved the greater curvature and posterior wall and extended into the lesser peritoneal cavity. It measured 9 by 8 by 4 cm. The portion which extended into the lesser cavity measured 9 by 4 by 4 cm.

peritoneal cavity was 5 cm. in diameter. There was a small ulcer on the intragastric portion 1 by 0.5 by 0.5 cm. (Fig. 4.)

Microscopic sections revealed a variety of cells, most of which resembled smooth muscle. (Fig. 5.) No mitotic figures were present. The pathologic diagnosis was leiomyoma.

CASE III. Mrs. J. C., a sixty-six-year-old housewife, was admitted to the Clinic October 9, 1944, with complaints of "nervousness in the stomach," bloating and insomnia. A year before similar complaints had led to an examination elsewhere during which it was found that she had diabetes mellitus. This had been satisfactorily controlled with dietary measures alone.

Physical examination disclosed a rather obese white female with moderate hypertension, 170/80, a systolic murmur over the apex, a large cystocele and rectocele, and a mass about the size of a large grapefruit was found on very deep palpation in the left upper quadrant of the abdomen.

Blood analysis disclosed 3.81 million red blood cells with a hemoglobin of 71 per cent (photelometer). There were 4,750 white blood cells with a normal differential. The Mazzini test was negative. Urinalysis revealed scattered pus cells in the sediment. Gastric analysis

disclosed free acid of 14 with total acid 32. Blood urea was 35.5 mg. per cent; fasting blood sugar was 114 mg per cent.

X-ray of the chest revealed the heart slightly enlarged with fusiform bulging of the aortic shadow suggestive of an aneurysm in the ascending portion. Roentgenologic examination of the gastrointestinal tract after ingestion of a barium meal showed displacement of the stomach and transverse colon upward and of the sigmoid downward by a large mass. Intravenous pyelograms revealed an outwardly displaced left kidney with no demonstrable connection to the mass.

Electrocardiogram revealed hypertensive changes in the heart.

The patient was admitted to the Clinic Hospital November 29, 1944, and on the following day a laparotomy was performed. Under cyclopropane anesthesia a left paramedial incision was made. Exploration revealed a single stone in the fundus of the gallbladder and a large smooth walled tumor, apparently arising from the omentum. This tumor was resected and during the procedure it was found that the mass actually arose from the posterior stomach wall near the greater curvature. The neoplasm was resected without entering the lumen of the stomach although stomach mucosa could be plainly seen. For this reason the incision in the stomach wall necessary for the resection was merely closed with two rows of catgut, the rent in the mesocolon repaired, and the abdomen closed.

During the operation and following twenty-four hours a total of 3,500 cc. plasma, whole blood and 10 per cent glucose in saline were administered intravenously to combat post-operative shock. After the first day the patient's course was uneventful and she was dismissed December 14, 1944.

The tumor measured 20 by 15 by 9 cm. and weighed 1421 Gm. (Fig. 6.) It was a solid, yellowish brown tumor with large, reddish brown to bright areas of old and recent hemorrhage and degeneration. The gross diagnosis was leiomyoma. Microscopic study, however, revealed round and oval cells tending to form lumens and spaces. Some of these contained blood. A microscopic diagnosis of hemangioendothelioma was made and this was concurred in by Dr. A. C. Broders. (Fig. 7.)

The patient was readmitted to the Clinic Hospital on June 14, 1945, because of attacks of pain in the right upper quadrant of the abdomen for six to seven weeks. There was a history of idiosyncrasy to greasy food, raw fruit, etc., and it was believed that these symptoms could be attributed to the cholelithiasis, noted at the time of the original operation. Blood analysis on the day of admission showed an 85 per cent hemoglobin and 8,350 white cells with normal differential. The icteric index was 6. Fluoroscopy of the stomach and colon was negative. Cholecystogram revealed a practically non-functioning gallbladder containing a single, partially calcified calculus about 2 cm. in diameter.

She underwent operation at the Clinic Hospital on June 18th. At this time a cholecystectomy was performed. The left lobe of the liver was enlarged and the possibility of metastasis from the stomach neoplasm was considered. However, the enlargement was so diffuse that it was thought that the liver disorder was a hepatitis. Examination of the stomach at the site of the previous operation revealed no induration or any evidence of a recurrence.

The patient really never recovered from the operation. On the day following operation, she developed an oliguria and a high temperature, which rose gradually without ever coming back to normal level. The blood urea gradually rose from 52 mg per cent on the second postoperative day to 92 mg. per cent on the fifth postoperative day. She expired on the sixth postoperative day.

An autopsy was performed one-half hour after death. As soon as the peritoneal cavity was opened, 200 or 300 cc. of clear fluid was found. There was no gross change at the site of the cholecystectomy. Careful examination of the stomach showed barely a scar at the site of previous operation. The spleen was two to three times normal size. The left lobe of the liver was carefully freed from fibrous adhesions in which it was buried and here there was a yellowish mass, probably 10 cm. in diameter, obviously a malignant neoplasm. Careful search throughout the liver revealed another nodule 5 cm. in diameter in the right lobe under the diaphragm. There was no enlargement of any lymph nodes nor any evidence of any further metastasis.

Sections on this tumor revealed tissue quite different from that seen in the tumor of the stomach. (Fig. 8.) The cells looked like typical

sarcoma cells and there was some attempt at vessel formation. These sections, together with the sections from the previously excised stomach tumor, were sent to Dr. A. C. Broders, whose opinion was as follows: "The sections from the stomach show typical hemangioendothelioma of a grade 1 malignancy, as per Dec. 20, 1944. I am of the opinion that the sections from the liver show a grade 1 hemangioendothelioma. These sections differ from the tumor of the stomach in that there is a marked tendency to imitate a fibro- or leiomyosarcoma. Not infrequently hemangioendotheliomas in other situations show this tendency. I am also of the opinion that the tumor in the stomach and the tumors of the liver are primary and hence independent of one another."

SUMMARY

Leiomyomas and sarcomas of the stomach must be considered in the differential diagnosis involving a large intra-abdominal mass. Leiomyomas give symptoms according to size, location and degree of pyloric obstruction, whether or not there has been malignant change in the tumor. Diagnosis can be made usually by x-ray study.

Treatment of such tumors is surgical following recognition. Lymphosarcomas represent the exception because of their radio-sensitivity.

The type of surgery depends upon the degree of involvement of the stomach and upon the presence or absence of malignancy as determined by fresh frozen section at the time of operation. Thus local excision, partial or total gastrectomy may be required.

Three cases in which the patients underwent operation at this clinic are reported.

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THE CAROTID BODY

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THIS subject has been beset with confusion since its inception. A multiplicity of terms are used to designate the anatomy and pathology. The physiology usually is mentally and anatomically intermingled with that of the carotid sinus. There exists similar organs histologically and physiologically, namely, the aortic body, innominate bodies, abdominal paraganglia and coccygeal bodies. This situation has hampered research of the carotid body in man.

The rarity of disease processes in the carotid body has not helped to advance the knowledge of this subject. Likewise the lack of physiologic and metabolic changes in the presence of pathological change has not furthered the scope of study of this entity. However, with the unassailable facts and certain unquestionably conclusive researches, the work of many men; some semblance of order may be derived from the existing welter of confusion.

History. In 1743, Haller first described the carotid body (confusion was born with the first concept of this structure for Haller also described the carotid sinus at the same time). In 1880, Reigner was the first to excise a carotid body tumor which was described histologically by Marchand. In 1892, Paltauf described the perithelial cells of the carotid body. In 1895, Middleton removed the first carotid body tumor in America. In 1927, Heymans, the Belgian, first published his discovery that respiratory reflexes could be elicited from the aortic area. Later brilliant researches of this worker and his associates correlated this work with the carotid body and conclusively demonstrated that these organs responded to chemical changes in the blood, namely, oxygen lack, and send out impulses through the medulary center which increase respiration.

Embryology. Boyd has assigned the anlage of the carotid body as the mesenchyme of the third branchial cleft, to be later inter-related with the artery of this arch and the glossopharyngeal nerve.

Anatomy. The carotid body (glomus caroticum, paraganglion intercaroticum, carotid gland) is a small flattened body approximating the shape of a kernel of corn, varying in size from 2 to 5 mm. in its long dimension. It is situated, bilaterally, immediately above the bifurcation of the common carotid, artery and lies directly on the medial surface of this artery and of the small contiguous medial portions of the internal and external carotids. It is grayish, brown-red in color and is hard. The blood supply is derived almost entirely from the external carotid, while the nerve supply is from the glossopharyngeal (IX, cranial nerve). The dissection and visualization of the normal body is tedious and difficult and is seldom seen in surgical dissections of the neck.

Histology. There is presented a fibrous capsule, which contains irregularly arranged columns or cords of pale staining epithelioid (perithelial) cells with pale nuclei closely applied to the endothelium of the sinuses. The perithelial cells are richly supplied with nerve endings of a specialized type.

Physiology. The carotid body may be considered as a small specialized blood chemistry laboratory (chemoceptor) acting primarily as a subsidiary to the medullary respiratory center. The carotid body goes into maximum action in certain emergencies particularly in severe anoxia (excessively lowered oxygen tension). It takes the blood sample, analyzes it, and sends stimuli to the medullary respiratory center. The response is increased respiration, i.e., depth and rate. The carotid

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body will send stimuli to the respiratory center which will in turn respond, under conditions that produce marked depression of the central nervous system.

Certain drugs, such as lobeline, nicotine, cyanides, sulfides and potassium salts stimulate the carotid body. These responses are evidenced by a gasp.

In the normal physiological processes of man this organ apparently contributes very little, but in the extreme emergency of severe anoxia (lowered oxygen tension) there would be thousands of deaths were it not for the carotid (and associated) bodies.

Pathology. The pathological processes that may occur in the carotid body, other than those occurring in contiguous organs in its vicinity, are limited to tumors.

Ewing classifies these tumors with the group called perithelioma, which has a more logical basis, (i.e., the cellular origin and structural features) than all other names ascribed (peri-vascular endothelioma, alveolar tumor, chromaffinoma, pheochromocytoma, paraganglioma). Marchand and Paltauf regarded the carotid body tumor as originating from the perithelial cells.

The tumor usually makes its appearance at puberty and is very slowly growing and essentially benign, although there have been recurrences after removal and the cervical lymph nodes have been found involved. General metastases have not been noted. The tumor is lobulated and encapsulated. They are firm or soft depending upon the quantity of the vascular element present; if soft they are compressible. They have been reported to exist for thirty years. The capsule may rupture. Portions of the tumor may undergo degenerative changes.

On section the tumors are very vascular, grayish-red or brownish-red, depending on chromaffin content. The markings show vessels, plexiform cell masses, concentric, and hyalin areas. Microscopically, the tumor presents polyhedral granular cells arranged in compact groups without a

lumen, but surrounded by hyperplastic endothelium lining the numerous capillaries. In the larger cell groups there may be central degeneration and necrosis; cavities may be formed which may fill with blood. Capillaries may traverse these cell groups. The more soft the tumor the greater the number of vessels. The stroma may be scanty and acellular or hyaline or infiltrated with tumor cells. Both the specific cells and the endothelium participate in the tumor process.

The carotid body tumor while infrequent is not rare. There have been over 250 reported in the literature and unquestionably many are not reported. In the hospitals of the Army of the United States, there have been four carotid body tumors removed with subsequent microscopic sections reported to U. S. Army Medical museum since January 1, 1942. This gives a carotid body tumor operative rate of about 1 in 1,700,000 individuals. The frequency of occurrence must be greater.

Physical Findings and Symptoms. The clinical findings are rather meager. The patient presents a history of a slow growing tumor, of the side of the neck under the sternocleido mastoid muscle having had its onset at or after puberty. There may be a familial history. The physical findings are negative except for the local ones. The tumor may be hard and if hard will elicit a transmitted pulsation from the carotid. If it be soft, the tumor will be compressible and may produce a bruit. The tumor is movable anteroposteriorly but extremely limited in motion in the superior, inferior axis. This is due to its encirclement of and attachment to the carotid vessels. It is usually unilateral, although cases have been reported bilaterally. The size varies from a few cm. to 9 cm. in its long diameter; there may be a bulging into the mouth and pharynx (without ulceration). The center of the tumor is at or near the location of the bifurcation of the carotid on the affected side.

There are presented no general symptoms. All are local and are due only to tumor expansion. The general health is in no way impaired nor is the individual's physiology deranged.

Differential Diagnosis. The distinctions must be made between the carotid body tumor and carotid aneurysms, brachial cysts, abscesses, inflammatory or enlarged lymph nodes, aberrant thyroids, lymphatic tumors either primary or secondary.

Treatment. The treatment is surgical removal. The tumors are not responsive to roentgen therapy. The operative mortality is approximately 30 per cent and this figure is derived from the mortality of ligation of the internal carotid with its attendant hazards.

Prognosis. Since the tumors are essentially benign, the prognosis is excellent if all the tumor is removed. There will be a recurrence locally if some of the tumor tissue is left behind. There have been cases reported in which lymph glands were invaded in the immediate vicinity. These must likewise be removed at operation. There have been no records of generalized metastases.

SUMMARY

There has been presented a review and classified condensation of the literature on this subject augmented by observations of several cases of carotid body tumor.*

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* This essay is based on observations during and prior to Army service.

INACTIVATION OF PENICILLIN BY TUBING

PRELIMINARY REPORT

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RECENTLY, Cowan[1] presented experiments which demonstrated that certain types of rubber tubing exert a deleterious effect on penicillin solution. He noticed that in some instances as much as 25 to 50 per cent of the penicillin may be inactivated before reaching the patient. Obviously this observation may be of practical importance in patients to whom penicillin is administered in form of intravenous or intramuscular infusion. The tubing may inactivate a certain amount of penicillin and as a result the patient receives less than the calculated dose of the drug.

Intramuscular infusions of penicillin are advocated by many physicians. On one hand, the thrombosis of veins associated with intravenous treatment is avoided and, on the other hand, an adequate and uniform blood concentration can be maintained without disturbing the patient for repeated intramuscular injections.

In view of the rising popularity of intramuscular infusions it seemed desirable to test the inactivation of penicillin not only by rubber tubing but also by various substitutes used for this purpose.

Dr. M. V. Novak, the Head of the Department of Bacteriology and Public Health, University of Illinois, College of Medicine, was kind enough to test the effect of the following products on penicillin: (1) new rubber tubing, (2) a translucent vinyl derivative, called "Tygon"* which can be used repeatedly and (3) a hydrocellulose product† which is discarded after a single use.

Cooke's[2] method of assay was used and

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* "Tygon" tubing was generously supplied by the U. S. Stoneware Company, Akron, O.

† The Hydrocellulose product was generously supplied by the Visking Corporation, Chicago, Ill.

the results were checked by the plate method of assay described by Florey[3] et al. All the material was autoclaved before being tested. The tubing was kept in contact with penicillin at room temperature.

Assuming that the average length of tubing used for infusions is 48 inches (1.2 m.) and that the time consumed for an infusion is two hours, the same numerical factor of $48 \times 2 = 96$ was obtained by immersing a 4 inch (10 cm.) long piece of tubing into penicillin solution for twenty-four hours $(4 \times 24 = 96)$; in two more series of experiments the contact was maintained for seventy-two hours and seven days, respectively. The results are shown in the accompanying chart.

The results demonstrated the considerable inactivating effect of the products tested on penicillin. For instance, after a contact of rubber tubing with penicillin for twenty-four hours, instead of 6.4 only 4.2 units of penicillin per 1 cc of solution were found. In other words, not less than 34.38 per cent of penicillin was inactivated.

PENICILLIN TITER UNITS PER CC.

	24 Hours	72 Hours	7 Days
Control	6.4	4.2	1.8
Visking Tubing	4.2	3.6	1.8
Tygon Tubing	3.6	3.2	1.2
Rubber Tubing	4.2	3.2	1.8

There was no marked difference between the various products · tested as far as the inactivating effect on penicillin was concerned.

Experimental errors such as contamination of solution or inaccuracy of the assay

method can only partially account for the inactivation of penicillin.

The mode of the effect of tubing on penicillin remains obscure and further experimentation is required to elucidate this problem. It is possible that certain brands of rubber tubing or its substitutes exert no inactivating effect on penicillin but it would be impractical to test each specimen of tubing before using it for a penicillin infusion. An overdose of penicillin appears to be harmless while an insufficient dose obviously will fail to maintain the desired concentration in the blood. Therefore, for the time being a conclusion is justified that the calculated dose of penicillin should be enriched by additional 15 to 30 per cent if the drug is to be given in the form of an infusion.

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STAPHYLOCOCCI are present at some stage of the infection in practically all severe wounds. These may be derived from the patient's skin, or from some outside source. The coagulase test should be performed with the staphylococci isolated. A positive result indicates that the coccus is of a pathogenic type. Staphylococci which give a negative coagulase test are not likely to be of major importance in a wound.

From "Surgery of Modern Warfare" edited by Hamilton Bailey (Williams and Wilkins Co.).

ROENTGEN AND CLINICAL PROBLEMS IN SO-CALLED SOLITARY METASTATIC TUMORS IN THE CHEST

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WITH the tremendous acquisition of skill and experience by the thoracic surgeons, the responsibilities of the radiologist in the examination and diagnosis of chest tumors have increased correspondingly.

Our object is to discuss without drawing any rigid or final irrevocable conclusions: (1) Solitary metastatic tumors of the chest, in five cases, subsequently operated upon, seen in our own x-ray experience; (2) eight reports of apparently solitary metastatic chest tumors, surgically removed, found in the medical literature; (3) personal communications favoring the surgical removal of solitary metastatic chest tumors after the operative removal of the primary tumor; (4) the low incidence of proven single metastatic tumors in the chest or for that matter anywhere else in the human body; (5) the impossibility of differentiating many benign from malignant tumors in the chest by roentgen means alone; (6) the difficulties in differentiating many primary from solitary metastatic tumors of the chest by x-ray methods alone; (7) our lack of knowledge of the natural life history of primary tumors and their metastases, making prognosis difficult when treated surgically or when left entirely alone. Metastases sometimes manifest themselves from five to fifteen years after proof of existence of primary cancer; and (8) the inadequacy of radiation therapy in dealing with primary or metastatic tumors of the lung, but its value as a diagnostic test in ruling lymphomas in or out in difficult cases which present mediastinal or hilar masses.

More than ten years ago, our interest in these problems was stimulated by the first of the following five cases:

CASE REPORTS

CASE I. A single white woman, aged twenty years, was admitted to the hospital in 1930 for removal of an olive-sized soft part tumor on the anterior aspect of her upper left forearm. Thorough excision and biopsy showed a fibrosarcoma of the soft tissues. Several months later another mass appeared at the operative site and grew rapidly and this was excised in 1931, approximately one year after the first operation. A third tumor appeared and was excised in 1932 and a fourth in 1933. In 1934, with additional tumor growth, the left upper extremity was removed by disarticulation at the shoulder joint. In July, 1935, the patient complained of pain in the chest and cough and roentgenogram of the lungs disclosed a solitary oval nodule 7 cm. in diameter in the right posterior thorax in the upper portion of the right lower lobe. Right pneumonectomy was attempted but the patient expired in the operating room. No necropsy or chemical studies were performed so that the immediate cause of death remains undetermined.

CASE II. A white woman, forty years of age, had an oöphorectomy after diagnosis of tumor of the ovary six years previous to her second admission to the hospital for pain in the chest and dyspnea. Roentgenograms of chest revealed an enormous solitary oval mass in the lower left posterior thorax over 15 cm. in diameter. Left pneumonectomy was successful and disclosed a granulosa cell tumor. The patient made a complete recovery but developed liver metastases in six months and died eight and one-half months after operation.

CASE III. A white male, about thirty-five, had a small heavily pigmented tumor which had been irritated removed from his posterior left shoulder region with a diagnosis of malignant melanoma. Four years later a roentgenogram of the chest showed a solitary oval nodule 6 cm. in diameter in his right lower lobe. Right pneumonectomy was performed and the patient was discharged in good condition but developed metastases and died less than twelve months after the operation.

CASE IV. A white woman, over forty-five, was treated with x-ray and radium therapy for carcinoma of the uterine cervix with apparent immediate success and three years later a roentgenogram of the chest revealed what appeared to be a large single metastatic tumor in the left upper lobe. Left pneumonectomy was successful but the operative specimen showed a large group of nodes of metastatic carcinoma at the left hilum. This is a recent case and there has been insufficient time to have survival be significant. The presence of other metastatic nodes found at operation suggests a grave prognosis.

CASE V. A colored male, aged thirty, had a slightly pulsating tender mass in his upper sternum. Roentgenograms disclosed irregular bone destruction in the sternum with no aneurysm or metastases in lungs or other bones. A primary bone tumor, osteolytic type of sarcoma, was favored by x-ray department, with the clinicians inclined to expect a liposarcoma, influenced by recent articles on the subject. Excision of the entire sternum was performed and the pathological report was "metastatic tumor probably hypernephroma." Subsequent intravenous pyelography showed an enormous left kidney tumor with poor function and very poorly outlined and deformed pelvis and calyces. Within six months the lungs showed multiple oval metastatic nodules and death soon followed.

Summarizing these five cases, they illustrate that thoracic surgery has reached a state of perfection where operative survival of metastatic chest tumors is obtainable, but the responsibilities of the radiologist have increased and his error in the last case was obviously disastrous.

In 1920, Meyer[20] performed left pneumonectomy on a five-year old boy, presumably for lung suppuration. The specimen showed lymphosarcoma in addition to bronchiectasis. The patient died ten hours postoperatively. Only partial necropsy was done and it is not known definitely whether this was a primary lung tumor or a metastatic one.

In 1933, Lilienthal[17] reported a case in which a left pneumonectomy was carried out for sarcoma, metastatic from the uterus. The patient died four days postoperatively. At autopsy, a small sarcoma of the uterus was found in addition to fibrocaseous tuberculosis of the right upper lobe with a healing cavity.

Barney and Churchill,[3] in 1939, reported, "x-ray evidence of a metastatic nodule in the lung was the first sign of the disease. A nephrectomy was performed 5 months later, and 15 months following the nephrectomy the pulmonary metastasis was excised by subtotal lobectomy. The patient is surviving five years later in good health without evidence of disease. They add that, "when one speaks of a 'solitary metastasis' it is meant that only one can be demonstrated" and that, "it is well known that single or multiple metastases may occur as late as ten years after the recognition and removal of the kidney tumor," and finally "if a metastasis is apparently solitary and accessible to surgical removal, it is definitely worth while to undertake removal of the metastasis as well as the primary growth."

In a second paper, Barney[2] reports again on his patient as a "twelve year cure following nephrectomy for adenocarcinoma and lobectomy for solitary metastasis," and actually this was thirteen years after the solitary lung metastasis was first demonstrated by x-ray and the nodule had increased in size between 1931 and 1932. The patient, a white woman, had attained an age of sixty-seven years and had no demonstrable disease and was asymptomatic.

In 1940, Churchill[10] said, "the status of pulmonary resection for known metastatic tumors of the lung is admittedly one of experimentation. In general, it may be taken under consideration when a solitary metastasis of a tumor of relatively low grade malignancy appears in the lung after complete eradication of the primary growth. It is also to be considered in cases of hypernephroma with a solitary pulmonary metastasis." According to Churchill, "resection of metastatic tumors is usually a simple matter technically as the complications of infection that are found in primary tumors are absent. Peripheral nodules may be removed en bloc and larger growths

resected by lobectomy or pneumonectomy with intrahilar or mediastinal dissection. Metastases to the bronchial wall may closely stimulate primary bronchogenic carcinoma as the signs and symptoms of bronchial encroachment result."

Raine,[23] in 1941, performed a right pneumonectomy for a single metastatic nodule invading and occluding the main bronchus. An oval mass penetrating the main bronchus beneath the upper lobe bronchus measuring 1.5 by 2. by 1 cm. was an adenocarcinoma similar to that found in the colon twenty-one months before. Symptoms had returned nine months after the first operation with the second operation one year later. At the time of the report, there were beginning symptoms of other visceral involvement in the patient, a fifty-nine year old white male. In the same paper Raine mentions two cases of hypernephroma metastatic to the lung with ulceration and invasion of bronchi diagnosed bronchoscopically.

In 1942, Carlucci and Schleussner[9] described a case in which a total pneumonectomy was performed for malignant melanoma of the right lung. The radiologist noted very little change in the size of the tumor over a three-month period. The patient died thirty-six hours postoperatively. On microscopic examination the tumor proved to be a malignant melanoma with involvement of the hilar lymph nodes. Permission for autopsy was not obtained.

Brezina and Lindskog,[7] in 1943, described a right total pneumonectomy for a discrete tumor of the right upper lobe, in a sixty-five year old white woman, on whom a subtotal hysterectomy and bilateral salpingo-oöphorectomy had been performed thirteen years previously for vaginal bleeding with a gross diagnosis of uterine carcinoma. Recent cough and blood tinged sputum caused the patient to seek medical help. The patient recovered from the operative procedure and the removed lung showed a solitary metastasis of uterine adenocarcinoma. The operation was done on April 17, 1943 and patient was last seen on September 29, 1943, a survival

of at least six months. The authors conclude that, "total pneumonectomy for metastatic cancer in the lung is at the present time an uncommonly reported operation." Incidentally, the radiologist had made careful laminograms of this tumor and had reported hilar lymph node enlargement suggestive of additional metastases. Actually only the single nodule was found and the roentgen impression of additional nodes was erroneus. As the examination was carried out in a department famed for its laminographic work, this is at least suggestive of the inadequacy of roentgen methods in determining the presence of single or multiple metastases. In our own case of metastasis from uterine carcinoma, we had diagnosed a single nodule and operation disclosed an additional group at the hilum, a roentgen error in directly the opposite direction in the same type of case.

Again in 1943, Deming and Lindskog,[12] reported the case of a man of fifty-four years, with papillomatosis of the bladder and entire urethra, later infiltrating cancer of the bladder and late metastasis to the right lung. Deming excised the penile urethra and Lindskog did a pneumonectomy for the pulmonary metastasis. They conclude that, "although the primary lesion (papillomatosis) has been fully under control for 13 years, the patient now has a metastasis to the right ilium and other osseous metastases will probably develop. The histologic classification of papillomata of the bladder gives no opportunity for optimism towards its inherent metastatic quality. The justification of eradication of a solitary distant metastatic lesion is supported on the basis of relief of symptoms and prolongation of life."

Blalock,[6] in 1944, in discussing recent advances in surgery said, "in a recent impressive personal experience, a right total pneumonectomy was performed for a large pulmonary metastasis that was detected more than four years after resection of the large bowel for carcinoma. The convalescence was uneventful and the patient left the hospital two weeks after

the operation. He returned to work, but pneumonia developed in the remaining lung four months after operation. This responded rapidly to sulphonamide therapy, and the patient left the hospital after a stay of one week. He returned to work one week later and has done well during the last three months. There has been a gain in weight of 11 pounds since the operation." This was a seven and one-half-month follow-up.

Willis,[28] in his book on "the spread of tumors in the human body" described as a "latent primary neoplasm"; that is, one in which the "attention of the clinician is focused on precocious metastases" while the primary tumor is silent. Our case of hypernephroma was such a case, and the patient did not have the benefit of removal of his primary tumor, before removal of the presenting single metastatic lesion, with the error in diagnosis directly the responsibility of the radiologist, and this in no way reflects on the skill of the thoracic surgeon who successfully removed the secondary growth.

Personal communications with many thoracic surgeons over a period of years emphasize that in certain cases in which the primary tumor has been removed and an apparently *single late* metastatic lesion appears, operative intervention is being considered as a chance possibility of completely eradicating the disease. I have purposely had this problem brought up in many important conferences,[14] for example, at the weekly radiologic conference at the Walter Reed General Hospital with the same "chance possibility of eradicating the disease" the prevailing argument for operation. Relief of pain, alleviation of respiratory distress and removal of a focus which might give rise to tertiary metastases have been other arguments in favor of surgery. The most discouraging aspect has been the lack of enthusiasm shown by pathologists as a group for these procedures, and again, large neurosurgical services routinely take chest films on their suspected brain tumor patients searching in particular for primary carcinoma of the lung,

as well as for incidental metastases or other lesions. The discovery of a primary carcinoma elsewhere has invariably cancelled the procedures contemplated by the neurosurgeons. Ventriculographic defects suggestive of metastatic lesions in the brain, while frequently not as convincing as nodules in the air-filled lung have likewise led to abandonment of operations.

Proven solitary metastatic tumors in the chest appear to be rare at autopsy. I can report such a case in a fifteen-year old white girl who had an osteogenic sarcoma of the upper right femur. A portable roentgenogram was made just before death searching for a terminal pneumonia and a single oval nodule was demonstrable at the first rib level anteriorly in the right upper lobe and necropsy confirmed the presence of only this single nodule on careful inspection of the lungs. However, Batson[4] mentions that careful workers (Walther and Willis) find microscopic carcinoma lesions in many lungs. In discussing the rôle of the vertebral veins in metastatic processes, especially in considering miliary tuberculosis, erysipelas and tuberculosis, Batson says, "Primary lesions in the left side of the heart, or in the lungs, may give rise to solitary, instead of multiple artery-borne secondary foci." In particular he says, "In miliary tuberculosis, the arterial blood stream distributes multiple foci at random. In erysipelas, the organisms invade a plexus of lymph vessels and multiply. As a result the primary lesion enlarges, colony like, from its margins. In tuberculous adenitis, the organisms spread in lymph vessels to multiply in the regional lymph nodes and lymph node chains. Modifications of the typical patterns are common. The microscopic size suggesting a young lesion, may indicate a tertiary lesion, i.e., one due to spread from a metastasis." These observations are in addition to his well known main contribution in which he, "demonstrated a set of valveless, plexiform, longitudinal venous channels that join the cranial venous sinuses to the pelvic veins without the intermediation of the lungs," and that,

"the vertebral vein system parallels the portal, the caval, and the pulmonary vein systems, providing a by-pass around these systems as well as serving as a venous pool during compression of the body cavities."

According to Rienhoff,[24] "the total removal of the lung for even a benign tumor may be required as a measure to save life," a fact demonstrated by one of the cases first reported by him in 1933. The large size of benign tumors interfering with circulation and respiration and their potential possibilities of growing even larger have been reasons favoring their surgical removal.

Pathologists[1,29] suggest a very low incidence of proven solitary metastatic tumors in the chest or elsewhere in the human body. The incompleteness of the average routine autopsy, lacking studies of head, spinal column, bones and extremities, and more frequently than not performed by a junior member of the department usually without direct supervision, and often without benefit of the clinical and laboratory findings and without an appreciation of the problems involved leave much to be desired. Baker[1] in studying metastatic tumors of the nervous system at the University of Minnesota says that, "Tumors metastatic to the nervous system are probably much more common than is generally suspected. The majority of intracranial metastases are probably hematogenous in origin. The most common primary sources in this series of 114 cases were the lung, the breast, the gastrointestinal tract and the kidney. Metastatic tumors comprised 17.9 per cent of all intracranial neoplasms studied at the University of Minnesota. He supplies a table of single and multiple metastases in a total of 101 cases, sixty-one multiple and forty single and adds that, "Since the entire brain was not available in every case for detailed pathologic examination, it is very probable that many of the smaller lesions were overlooked and that the percentage of solitary metastases here stated is somewhat high."

The clinical symptom of hemoptysis is not a differential point between primary and metastatic lung cancer. King and Castleman[15] in necropsies at the Massachusetts General Hospital over a ten-year period on patients with metastatic pulmonary neoplasm investigated to discover incidence of those in whom actual invasion of bronchus occurred. In 109 cases of pulmonary metastatic tumor 18.3 per cent showed bronchial invasion. They state that, "Metastatic pulmonary neoplasm may simulate a primary tumor," and that, "blood streaked sputum cannot be considered pathognomonic of a primary tumor," but it is rare in metastatic pulmonary neoplasm—in four of 109 cases.

It would be difficult to disagree with Ochsner and DeBakey[22] that, "the determination of the type of lesion, its location, and the presence of demonstrable metastasis is of prognostic and surgical significance. In the discussion of their paper it was brought out that primary adenocarcinomas of the lung were circumscribed, epidermoid carcinomas were uncircumscribed, and hilar masses were oat cell carcinomas, with the hilar masses more doubtful than the others. Mulligan and Harper[21] stress that the location of primary lesions is of no diagnostic value as they are fairly equally distributed through various lobes.

According to Graham, Singer and Ballon,[13] "Involvement of the mediastinal glands by metastatic tumors is common. Hypernephroma and carcinoma of the thyroid not infrequently metastasize to these glands, and carcinoma of the lung is frequently recognized roentgenologically because of the associated metastatic involvement of the mediastinal glands."

Dissecting aneurysm, multiple and single aneurysms of aorta are at times terribly difficult to differentiate from tumors.

Throughout the literature hypernephromas seem to be given special consideration in considering the subject of metastatic growths. In a personal communication to Bumpass,[8] Frances Carter Wood said,

"In a good many of the hypernephromas the intravascular growths must often undergo spontaneous destruction. It is difficult, for example, to think of anything else, whereas I remember a bone metastasis in the tibia occurred which was removed but the primary growth stayed quite a long time. It is scarcely possible to think that there were not other emboli set free in the circulation similar to the one which gave rise to the tumor of the tibia." Beer,[5] in a paper on "some aspects of malignant tumors of the kidney said, "Late metastases in hypernephroid tumors are not infrequent, and solitary distant metastases may be the first evidence of disease of the kidney." "Distant metastases to the adrenals, bones, liver, kidney, lungs, brain, and occasionally to most unusual sites, may also appear early or very late, 7 to 10 or more years following nephrectomy. These late metastases are often solitary and unfortunately we do not know just what biological forces delay the development of these secondary tumors. They surely must have been deposited (if solitary) prior to the nephrectomy but some forces in the patient's body hold them in check for many years."

In 1944, Rienhoff's[25] paper on the present status of the surgical treatment of primary carcinoma of the lung showed that in "181 cases the roentgenogram of the chest was positive in every instance" in that the films showed an "abnormal shadow which necessitated further study and examination." Rigler claims diagnoses by finding localized areas of obstructive emphysema on films made on expiration where a small new growth is incompletely occluding a bronchus producing the well known ball-valve action of so many non-opaque foreign bodies. He also suggests the use of planigrams. Churchill[11] stresses the central location in large bronchi near hilum of benign adenoma.

In 1945, McDonald, Harrington and Clagett[18] in discussing hamartoma (often called chondroma) of the lung said "a hamartoma should be suspected in every case of solitary lesion of the lung." How-ever, they go on to say that roentgenologically they are very suggestive of a Ghon complex largely because of their subpleural situation. A practical instance of how this knowledge of recent literature may lead one astray can be found in recent case records of the Massachusetts General Hospital.[19] The clinical diagnosis was neurofibroma of the posterior mediastinum. Sosman's diagnosis was hamartoma of the left lung. The final anatomical diagnosis was sarcoid of mediastinal lymph nodes.

Laipply and Shipley[16] have very recently reported seven cases of extragenital choriocarcinomas in the male. An excellent example is that of a male, aged thirteen years, with intermittent pain at the left nipple, diffuse pulsation of the left thorax, large breasts, small testis, feminization and a single tumor 13 by 12 by 8 cm. extending out from the left superior mediastinum laterally extending between the lobes of the left lung completely encapsulated except at one point for 1 cm. Removal in 1936 was followed six and one-half years later by mediastinal tumor and metastases. Hormone assays on twenty-four-hour urine specimens for gonadotropin, estrogen, 17 ketosteroids and pregnanediol to evaluate the hormones elaborated by chorionic tissue of tumor as in pregnancy were the important studies in this case, not laminagrams or oblique views, or fluoroscopy.

Before closing I wish to present three cases which represent oval masses in the chest, which ordinarily by their appearance and location represent common lesions seen in any large radiological service.

First, a large dermoid cyst which extends along the right mediastinal border far anterior in the thorax. Second, a large neurofibroma so frequently high and posterior presenting in dumbbell-like fashion from the spinal canal. Various types of carcinomas and Pancoast's tumor with Horner's syndrome are difficult to differentiate in this location and we have made errors frequently in both directions. Thirdly, an oval mass in the lower right chest as seen on routine postero-anterior

film when studied more carefully was shown to be a bony tumor arising from the eleventh dorsal vertebra, blocking the spinal canal as shown on lipiodol injection. The thoracic and neurological surgeons working as a team removed a large chondrosarcoma and radiation therapy was given to the base of the tumor not resectable with the patient known to have survived two years.

Lastly, we present a case with a large, oval, right hilar mass thought to be a primary carcinoma but pneumonectomy disclosed Hodgkin's disease. With unsuccessful biopsy by bronchoscopy as in this case, a few hundred roentgens of deep x-ray therapy might have served as a diagnostic test. Response to radiation would have suggested one of the lymphoma group of tumors, the only group which deserves radiation therapy as a single method of treatment in this location.

To attempt to irradiate with cancericidal doses radioresistant squamous cell epitheliomas, adenocarcinomas or oat cell carcinomas in the poor tumor bed of the tracheobronchial tree and lung alveoli is obviously disastrous.

CONCLUSION

The many problems of solitary metastatic tumors of the chest remain unsolved and with due humility the highly experimental nature of their treatment has been indicated.

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SUBMUCOUS HEMORRHOIDECTOMY*

A MODIFICATION OF THE CALMAN METHOD

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HEMORRHOIDS are a very common condition. Many individuals have symptoms referred to this source at some period of their life and many require and receive treatment. The purpose of this paper is to present a surgical procedure for the correction of hemorrhoids. To clarify the surgical procedure the normal anatomy with its blood and muscle supply is reviewed.

Hemorrhoids are dilated veins in the region of the anus and lower rectum and have been defined as vascular tumors, or varicose veins of the rectal mucosa. Anatomically, the mucosal lining of the rectal canal extends downward to the region of the anorectal ring and consists of a pale pink, semi-transparent, columnar epithelium. The veins draining the hemorrhoidal plexus may be seen beneath the mucous membrane if the mucosa is not scarred or swollen from edema. The blood vessel supplying both the internal and the corresponding external hemorrhoid lies in the submucous layer beneath a fold of rectal mucosa. The artery within the fold can be easily palpated and frequently the pulsations may be seen. A large vein is adjacent to the artery. The fold of rectal mucosa containing the artery and its accompanying vein comprise a pile pedicle; the artery is termed the pedicle artery, and the vein, the pedicle vein.

The anal mucosa extends from the anorectal ring to the valves of Morgagni or anocutaneous line. The mucous membrane consists of several layers of cuboidal epithelium and is of a dark plum-like color because of the underlying venous plexus. While the rectal and the anal mucosa are not sensitive to pain from trauma, the mucosa is extremely sensitive to stimuli from traction or distention. The skin-like lining of the anal canal extends from the valves to the perianal skin. It is dull, white, smooth, adherent to the subjacent tissue and is extremely sensitive. It contains modified squamous or transitional epithelium which has the structure of skin, except that it does not contain hair follicles or sweat glands. The submucous space is situated in the anal canal lying between the mucous membrane and the internal sphincters and there are numerous veins within it adjacent to the anal mucosa. These veins, together with a variable amount of fibrous tissue, form the internal hemorrhoidal plexus. This plexus should be distinguished from the internal hemorrhoidal mass which consists of the internal hemorrhoidal plexus and its mucosal covering.

The anal canal is encircled by the sphincter muscles. The external muscle is a thick, powerful, voluntary muscle and in patients with prolapsed internal or thrombotic external hemorrhoids pain is due to spasm of this muscle. The external hemorrhoidal plexus lies on the anterior surface of this muscle. Above, the muscle is separated from the superficial external fibers by a well defined intermuscular septum; it is separated from the lower end of the internal sphincter muscle by the insertion of the longitudinal muscle of the anal canal.

The diagnosis of internal hemorrhoid is not always easy or obvious. The patient gives a history of pain associated with defecation and occasionally there is a

history of the internal hemorrhoid protruding through the anus. Diagnosis from external inspection alone is usually not possible, unless the hemorrhoids are prolapsed. The soft, compressible, internal hemorrhoid is usually not discernible by palpation with the gloved finger alone, and in order to make a definite diagnosis, the anal canal should be examined visually. Proctoscopic examination of the lower rectum in the knee-chest position will show the presence or absence of internal hemorrhoids in the majority of cases. The patient is requested to bear down and the examiner everts the anal orifice bringing the internal hemorrhoids, if present, into view. The size of the hemorrhoid will vary with the degree of venous distention.

The pain associated with the hemorrhoid is produced by spasms of the external sphincter muscle due to inflammatory edema from the mucosal fissures, thrombus formation, or strangulation of the internal hemorrhoids. The degree of pain varies with the severity of the spasm. The veins of the hemorrhoidal plexus and the adjacent soft parts may become secondarily infected and the result may be chronic inflammation and thickening. In addition to the dilatation of the venous channels, there is swelling and edema of the overlying soft parts. Such hemorrhoids are especially painful during and immediately after defecation.

Thrombosed external hemorrhoids are usually best seen immediately after defecation and are frequently very painful. Their size depends upon the degree of venous distention. Small thromboses usually consist of clots within the lumen of the veins of the external hemorrhoidal plexus. Some of these rupture into the perianal region with the formation of extensive thrombi. Occasionally, some of the small clots resolve without treatment. When the discomfort is intense, relief may usually be obtained by releasing the clot. Thrombotic hemorrhoidal masses which have prolapsed are best treated conserva-

tively, until the inflammatory edema and secondary infection abate. Surgical procedures may then be indicated. When the prolapsed hemorrhoid has become compressed by the spasm of the external sphincter a vicious cycle results. The spasm of the external sphincter interferes with the hemorrhoidal circulation so that the hemorrhoid gradually becomes swollen, discharge results, and eventually sloughing occurs; the more extensive the physiopathologic change in the hemorrhoid, the greater the external sphincter spasm. Pain may increase in severity and may become intolerable so that it is often necessary to administer a low spinal anesthesia to break the reflex arc and give relief. Sloughing may progress and a spontaneous cure of the hemorrhoid may result, but this does not happen frequently and should not be anticipated. The patient should be treated with bed rest and given a low residue diet. Relief usually obtains with the use of continuous hot moist compresses and a heat tent. Local use of one of the cocaine derivative preparations also may be comforting. Three weeks after the onset of the illness, after all the acute symptoms have subsided, the hemorrhoids may be removed by surgery.

A low spinal anesthesia has been found to be the most satisfactory anesthetic. It may be given easily and quickly and is less traumatizing. Caudal anesthesia does not always completely relax the anal sphincter. Sacral anesthesia requires multiple punctures, and at times some of the foramina may be difficult to find. Too, after sacral anesthesia is given, it may require some time before anesthesia is complete. In low spinal anesthesia the relaxation of the anal sphincter is profound. The same degree of relaxation cannot be obtained by other than very deep general anesthesia, which may be followed by vomiting and general discomfort, and rectal bleeding may also be induced. Dilatation of the rectal sphincter is a very profound respiratory stimulant, and the excessively deep inspirations which

result may occasion the inhalation of too great a quantity of the general anesthetic agent if it is used. The relaxation afforded by spinal anesthesia is very important and permits the operation to be performed with a minimum of trauma. Convalescence is therefore more rapid and comfortable. There is practically no untoward post-operative anesthetic reaction, and nausea and vomiting are usually absent.

Preoperative purge is omitted, hence soiling and obstruction of the operative field does not occur. The patient receives the usual preoperative sedation. An hour or two hours before the operation an enema of a 5 per cent solution of sodium bicarbonate is given and continued until the return flows clear. Two or three washings usually suffice.

A modified Jones position (that is a lithotomy position with the legs straight up) has been found to be the most suitable for the operation. The table is placed in a slight degree of reverse Trendelenburg. The modified Jones position is neither tiresome nor harmful to the patient. By having the legs straight up, pressure upon the popliteal space is avoided, and easy access to the operative field is permitted the surgeon, his assistant, and the nurse. The slight degree of reverse Trendelenburg brings the primary hemorrhoids more fully into view, and also distends the secondary hemorrhoids, which might ordinarily not be visible in the jack-knife or Sim's position.

The operative field is surgically prepared and draped. Dilatation is always done as a preliminary procedure to any hemorrhoidectomy. It should not be a rough, hasty, traumatizing tearing of the mucous membrane and muscle; instead, the sphincter should be slowly and carefully divulsed with a gentle adequate stretching of the part. The subcutaneous portion of the external sphincter is divided in those patients who have a contracted anal ring, or where scarring of the ring prevents dilatation. If the sphincter is properly and adequately dilated, there is no extrava-

sation of blood into the muscle or rupture of muscle fibers, and the postoperative pain is lessened. This has been particularly noted when a spinal anesthesia has been used. After the sphincter is satisfactorily dilated, a large sponge is placed into the rectal canal above the hemorrhoidal masses to stop any fecal seepage.

The tab of skin corresponding with the hemorrhoid showing the greatest tendency to prolapse is grasped with an Allis clamp and pulled laterally from the anus. The Allis clamp acts as a lever to dislocate the hemorrhoidal mass outward over the end of the gloved finger which is used as a fulcrum. This tension causes the anal mucosa covering the internal hemorrhoid to be displaced outside the anal canal. The hemorrhoidal mass is grasped with a T clamp. Further traction brings into view a longitudinal fold of rectal mucous membrane and fully exposes the hemorrhoidal plexus with its pedicle. The pedicle vein is clearly visible and the pedicle artery can be easily palpated. A No. 000 chromic catgut suture ligature is placed around the pedicle at a distance from the hemorrhoidal plexus; it encircles the vessels and is tied snugly. No untoward effects have been noticed from the ligation of the artery and vein. The suture ligature is repeated on each side of the hemorrhoidal plexus just within the mucocutaneous line but avoiding the skin and deeper structures. The second suture ligature catches the circular veins which communicate between the hemorrhoidal plexuses; thus, all tributary vessels and all branches are ligated. The T clamp is now removed. By proper manual retraction the assistant maintains the operative field in view. A small transverse incision is then made at the mucocutaneous junction of the exposed hemorrhoid. The free edge of the incised mucous lining is undermined along the entire length of the underlying hemorrhoidal plexus with a small, blunt, curved, flat-bladed scissors. A longitudinal incision is then made with the blunt straight scissors along the midline of the

mobilized flap so that the long axis of the incision is parallel to the long axis of the bowel. The mucous membrane is then dissected free laterally, in both directions from the underlying exposed veins. Dissection with the points of the scissors is usually necessary to free the mass completely of dilated and tortuous veins. Very little bleeding is produced during this dissection because of the previously placed suture ligatures. The hemorrhoidal plexus of veins is now removed and the sphincter muscle is exposed.

An Allis clamp is applied to the skin over the distended external hemorrhoid. While traction is exerted inward with the Allis clamp an incision is made in the skin of the anus on both sides of the Allis and extends from the anocutaneous line to the outer border of the distended external hemorrhoidal plexus. The incisions are made so that they meet at their outer extremities outlining a v-shaped section of tissue over the external hemorrhoidal plexus. Starting at the apex of the v, the tissue is dissected. The tissue dissected includes the skin and that part of the external hemorrhoidal plexus corresponding with the internal hemorrhoid which is being removed. The operative field is now covered with two flaps of mucosa. If the flaps are too redundant, they should be trimmed to the desired width. The mucosal flaps are approximated with No. 000 chromic catgut, and the skin incision is also closed with a continuation of this suture. A quarter of an inch v-shaped defect is left for drainage to insure against the collection of fluid and resulting infection and breakdown. The rectal sponge is now removed. No plug, tube, or drain is inserted into the anal canal, since this would produce rhythmical contractions of the sphincter in an attempt to expell the foreign body, thus resulting in sphincter spasm and pain which becomes increasingly more severe. The perineal area is washed with warm water and a sterile perineal pad is applied.

The patient is returned to bed and is given a regular low residue diet as tolerated. Fluids by mouth are not withheld. No attempt is made to constipate the patient. If the patient has not had a bowel movement by the third day and there is discomfort, a small retention enema of warm oil may be given but it is not often necessary. In warm weather these patients may take half-hour Sitz baths four times a day beginning on the first postoperative day. In cool or cold weather, hot moist compresses are applied four times a day for half an hour. The patients are permitted to be out of bed and walking around twenty-four hours after the operation. After forty-eight hours, nearly all the postoperative edema has abated. About 90 per cent of these patients may be discharged on the third or fourth postoperative day. The incidence of postoperative pain has been so little that morphine has only rarely been used, and then, one or two doses will usually suffice.

COMMENT

There are several advantages to the described method of hemorrhoidectomy by ligation. First, perfect hemostasis is assured by the ligation of the pedicle vessels and the circular veins and this provides a dry field for dissection. No case of postoperative hemorrhage has occurred. Second, there is no sacrifice of any rectal mucosa and all or as many hemorrhoids as desired may be removed at one operation. The patient is thereby spared the discomfort of a second or even a third operation. Third, the sensory nerves of the anus and the subcutaneous external sphincter muscle are distal to the point of ligation. Thus, these sensitive tissues are excluded from the ligation, sphincter spasm and pain are thereby avoided. Fourth, because there is no loss of mucosa there need be no fear of subsequent stricture formation. Not a single case of stricture was seen. The two flaps of healthy mucosa covering the raw surface agglutinate promptly. The edges unite rapidly and

leave only a very fine longitudinal scar hardly visible or palpable six months after the operation. Patients thus treated will be found to have very little local reactionary edema, and healing progresses with the minimal discomfort or pain.

The only disadvantage of the procedure described is that it takes a little longer (about fifteen minutes) than the other recognized and accepted types of hemorrhoidectomy, but the operating time does not exceed forty-five minutes. The final results, however, more than justify the extra time required.

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CONSTIPATION may be a general medical problem, a gastroenterologic problem or a proctologic problem. If the passage of hardened feces results in development of an anal fissure, the management is certainly proctologic.

From "Ambulatory Proctology" by Alfred J. Cantor (Paul B. Hoeber, Inc.).

Case Reports

ABSENCE OF THE VAGINA, UTERUS, RIGHT KIDNEY AND URETER AND ECTOPIC (PELVIC) LEFT KIDNEY

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THE urinary and reproductive systems are intimately associated in development. Both arise from the mesoderum of the intermediate cell mass (nephrotome), which unites the primitive segments with the lateral layers of somatic and splanchnic mesoderm. Therefore, coincident anomalies of both systems are common.

In vertebrates, three distinct types of excretory organs develop successfully, one caudad to the other. The first or pronephros develops at the fourth week of fetal life from the seventh to the fourteenth nephrotomes, and degenerates at the fifth week. The mesonephros or Wolffian body develops from the tenth to the twenty-sixth nephrostome segment at the fourth week before the pronephros disappears.

The developing mesonephric tubules begin differentiating and expand and bulge ventrally into the coelom thus producing on each side of the dorsal mesentery of the mesonephros, the longitudinal urogenital fold or ridge which extends from the fourth cervical to the third lumbar segment.[2,6,7] This ridge becomes divided into a lateral mesonephric fold, the anlage of the Müllerian ducts, and a medial genital fold, the anlage of the genital gland. As the cranial portion of the mesonephros degenerates, the urogenital fold passes lower into the body cavity, unites in the midline and forms the genital cord. Each mesonephric tubule unites with the pronephric duct, the vestigial remnant of the pronephros, to form the Wolffian or mesonephric duct. The caudal end of this duct is the ureteral anlage or bud of the collecting system of the permanent kidney (ureter, pelvis, calices, collecting tubules).[2,16]

The Müllerian duct or precursor of the Fallopian tube, uterus and vagina is laid down in the third thoracic segment in each urogenital fold, the first month of fetal life in the 10 mm. embryo. This appears as an epithelial thickening lateral to the Wolffian body. The Wolffian bodies in the female become rudimentary. The Müllerian duct lengthens, grows caudally and descends toward the pelvis, and develops a lumen in its growth. When the urogenital folds unite in the midline to form the genital cord, the lower or caudad portion of the Müllerian ducts fuse superficially first, to form the uterovaginal canal. The intervening septal wall becomes absorbed forming the normal uterus and vagina. The divided cephalic portion of the Müllerian ducts become the Fallopian tubes. This is the normal course of development.

Abnormal malformations usually result from developmental inhibitions rather than aplasia or absence of structures. Characteristic malformations of the urogenital organs are obtained by total or partial agenesis of the anlages, and complete or incomplete non-fusion of the Müllerian ducts. Absence of both urogenital folds is incompatible with life. By the same token absence of both ovaries which develop from the genital ridge, or absence of both kidneys which develop from the caudal end of the mesonephric duct occurs only in non-viable monsters.[5,16] Felix,[7] quoting von Winckel, has pointed out that complete absence of both Müllerian ducts with resultant

absence of tubes, uterus, and vagina never occurs in a living subject. Absence of one urogenital fold leads to total aplasia of the kidney and Müllerian duct on that side, and Felix[7] states conversely that complete absence of one Müllerian duct occurs only in association with total absence of the urogenital fold, its organs and kidney of that side.

The earlier literature quotes genital defects in association with absence of the kidney. Beumer, quoted by Radasch,[12] found thirteen associated genital defects, eight in females, in forty-eight cases of absent kidney between 1853 and 1878. This in the females, was reported as absence of one tube, half the uterus, or vagina. The ovaries were present. Eschaquet, in 1875, also quoted,[12] described a case of non-development of the left kidney, ureter, ovary, tube and one-half the uterus. Polk, in 1883, and also More similarly quoted[12] reported cases of absent kidney, ureter, uterus and vagina. Ballowitz[12] found seventy-three genital defects to 1895, forty-one in females in 213 cases of absent kidney. In five the uterus and tubes were both absent, in one the uterus and vagina were absent, in three the ovary was absent, and in three the tubes were absent. Buss, in 1899, quoted by Cullen in Dean Lewis,[5] reported a case of genuine aplasia of one Müllerian duct and urogenital fold in which the vagina, uterus, right tube, right ovary, right ureter and right kidney were missing. Guthrie and Wilson[9] reported a similar case and Eismayer in Dean Lewis[5] collected six cases of homolateral absence of the kidney, ureter, ovary and Müllerian duct (tube, uterus, and vagina). In the entire literature prior to 1923 only twelve cases of unilateral absence of an ovary has been found.[5] Adams,[1] in 1929, reported a case of congenital absence of the left kidney, ureter, uterus, tubes, broad ligament and vagina. Collins,[3] up to 1932, collected 581 cases of congenital unilateral renal agenesia which among other associated abnormalities included 203 various degrees of defects of the female genitalia. Among these there

were listed eleven cases of absent uterus and vagina, ten cases of absent tubes, ovaries and ligaments, one case of absent vagina, eight cases of absent female internal genitalia, one case of absent external female genitalia, and three cases of absent round ligaments or a total of thirty-four cases with absent female structures. The preponderance of associated malformation of the female genitalia with congenital renal agenesia is due to the later development of the Müllerian duct in relation to the Wolffian duct. Therefore, its opportunity of undergoing malformation is increased. Counsellor and Sluder[4] report thirty-five cases of absent vagina operated upon by them. Not one of the patients was reported as having absence of the uterus. Of the fifteen patients examined urologically, six had congenitally absent kidney, two had ectopic pelvic left kidneys, one had a duplicated left ureter, and six were normal.

From the above it is apparently true that complete absence of a Müllerian duct is associated more frequently with partial absence of the urogenital fold since the lateral nephritic portion (kidney) is absent while the genital portion (ovary) is present. Such a condition often tends to produce a true unicornuate uterus as illustrated by Shumacker,[10] who collected twenty-seven such cases. True unicornuate uterus is an unusual abnormality and its association with renal agenesia is rare. The above is further illustrated by the marked frequency of isolated single kidney in comparison. This has been variously determined to range from one case in 695 to one case in 8,000 autopsies.[3,4,12,16]

Ectopic kidney on the other hand is accounted for by the failure of the kidney to reach its definitive position.[3,16] During the early intrauterine period the primitive kidney occupies a position in the region of the future true pelvic cavity. The actual migration of the kidney is slight and is completed at an early stage, for the kidney becomes fixed while the ureter is still short. As a consequence of incomplete migration

the kidney may permanently assume an abnormal position and be arrested in the pelvic, iliac or lumbar region. Further apparent migration of the kidney is caused by the rapid growth of the body between the kidney and the vesical end of the ureter. The pelvic region is the most frequent site of an ectopic kidney.

The Fallopian tubes (which are part of the Müllerian ducts) are usually present in rudimentary form in most cases of absence of the uterus. This is the common form of defect, as in the case presented below and illustrates the developmental inhibition of the Müllerian duct. Here the Müllerian ducts are completely ununited and become widely separated. The Fallopian tubes resulting usually end blindly in the peritoneum behind the bladder in the broad ligament. This is associated with partial absence of a urogenital fold, for the ovary is present. At times the median end of the tube may terminate in endometrial tissue, a miniature uterus capable of menstruation, which may even give rise to fibroid tumors,[11,15] or the tube may become the seat of hematogenous infection.[13] Such individuals as in the case presented, have well developed secondary sex characteristics. (Fig. 1.)

The following case is of particular interest because of several features which will be elaborated in the case presentation. The first is the unusual complaint of progressive loss of vision over a period of four years with no other associated symptom, and the accidental discovery of the true condition by routine examination. The second is that the associated anomaly of an absent and an ectopic kidney was not recognized or suspected preoperatively, although with the methods available it should have been. This then, serves to reëmphasize the observation of numerous authors that cases of genital malformation require careful urologic investigation, and vice versa.

CASE REPORT

C. V. C., a seventeen-year old white female was referred by an optometrist July 21, 1945,

because of his inability to fit the patient with glasses and correct her vision. On fundoscopic examination he had noted a cloudy vitreous and he was unable to visualize the retina.

This girl's only complaint was failing eyesight for one year. This on questioning was found to antedate progressively the past four years. The opinion of her family was that she had cataracts since there was a familial predisposition to this. Her occupation was that of fruit picker.

The patient was delivered normally, in Arkansas, April 28, 1928, the second of three siblings and weighed nine pounds at birth. The sister was two years her senior, the brother five years her junior; both were normal. She was nursed at the breast and developed more rapidly than either of the siblings, speaking words at eleven months and walking at fourteen months. School was begun at six years of age and her progress was described as average. In 1941, at the age of thirteen she was examined routinely by the school doctor in Arkansas, and told her eyes were weak and that glasses were required. Nothing more was done at this time. At fifteen years of age her mother discussed menstruation with her, she had not menstruated as yet, but since the mother began menstruating at sixteen, no undue alarm regarding menses was felt until recently. Her eye sight became progressively worse and in March 1945, she consulted an eye specialist in Arkansas. At this time she could not see to read, but glasses could not be fitted. In April, 1945, she arrived with her family in California to work as a farm hand.

Inventory by symptoms were as follows: She had a good appetite, no food intolerance, no nausea or vomiting, regular bowel movements, no abdominal pain or tenderness and she had gained ten pounds the past three months. Respirations were normal; there was some dyspnea on exertion and some ankle edema for the past several months. She complained of nocturia two times for an unrecalled period. There was no polyuria, polyphagia, lumbar pain, facial edema, dizziness, headaches or paresthesias. She did not complain of spots before the eyes; objects were blurry and she was unable to read ordinary print for the past six months. She had never menstruated but had had lower abdominal cramps every month which began at fourteen years of age and lasted a day. At the end of a year the

cramps occurred every two months and this past year the cramps recurred every two to four months. When questioned whether she

in good health, developed cataracts at the age of twenty-nine and was operated upon in 1940. Her mother's brother was also operated
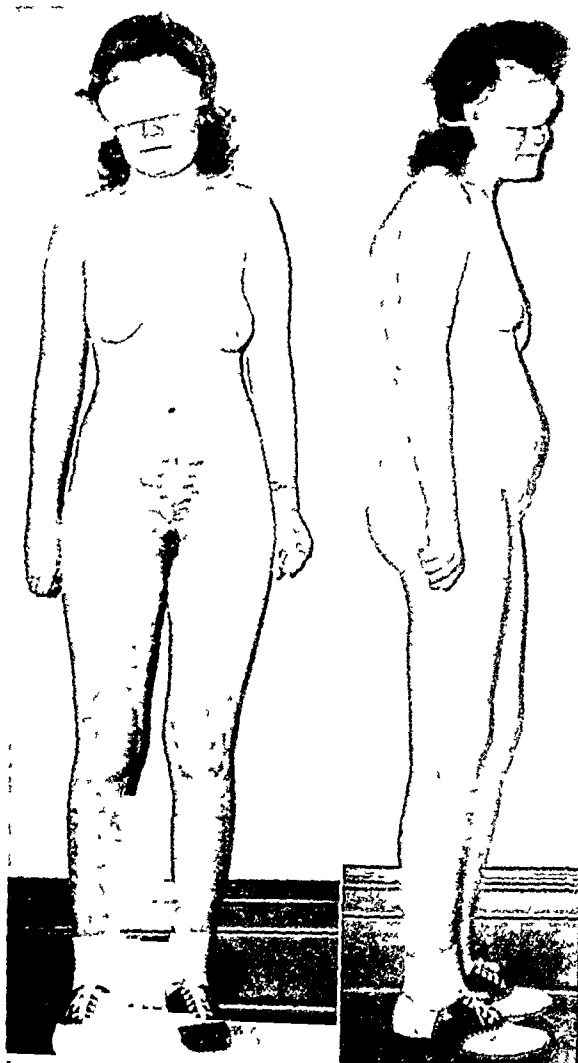
FIG. 1. Patient C. V. C., illustrating normal feminine development; photo nine weeks postoperatively.*

knew of her abnormality, she stated she thought she did. Her mother never knew of her defect. Her libido was apparently normal. She had kissed boys several times and had been caressed. Her past medical history revealed the usual childhood diseases including measles, mumps and pertussis; she had never been vaccinated. At the age of five months she had a carbuncle on her back which lasted two years and was incised once. There was no other surgery.

The family history revealed a tendency to cataracts. Her mother now thirty-eight and

upon for cataracts in 1945, after developing them in 1944 at the age of thirty-two. Her mother's mother now seventy-two underwent a similar operation in 1923. Her father's mother died of tuberculosis as did two aunts on the father's side. There was no history of carcinoma or diabetes. Her father and mother were divorced twelve years ago and the mother had subsequently remarried. The sister had a normal birth of a baby while the patient was confined in the hospital.

Physical examination revealed an exceptionally well developed and well nourished

* Photography by R. H. DeWitt.

seventeen year old white female. (Fig. 1.) Her height was 156.2 cm. (61½ inches), weight 68.1 Kg. (150 pounds), blood pressure 130/90,

tenderness, herniations, or palpable organs were present. Inspection of the pelvic structures revealed what first appeared to be an

A   B
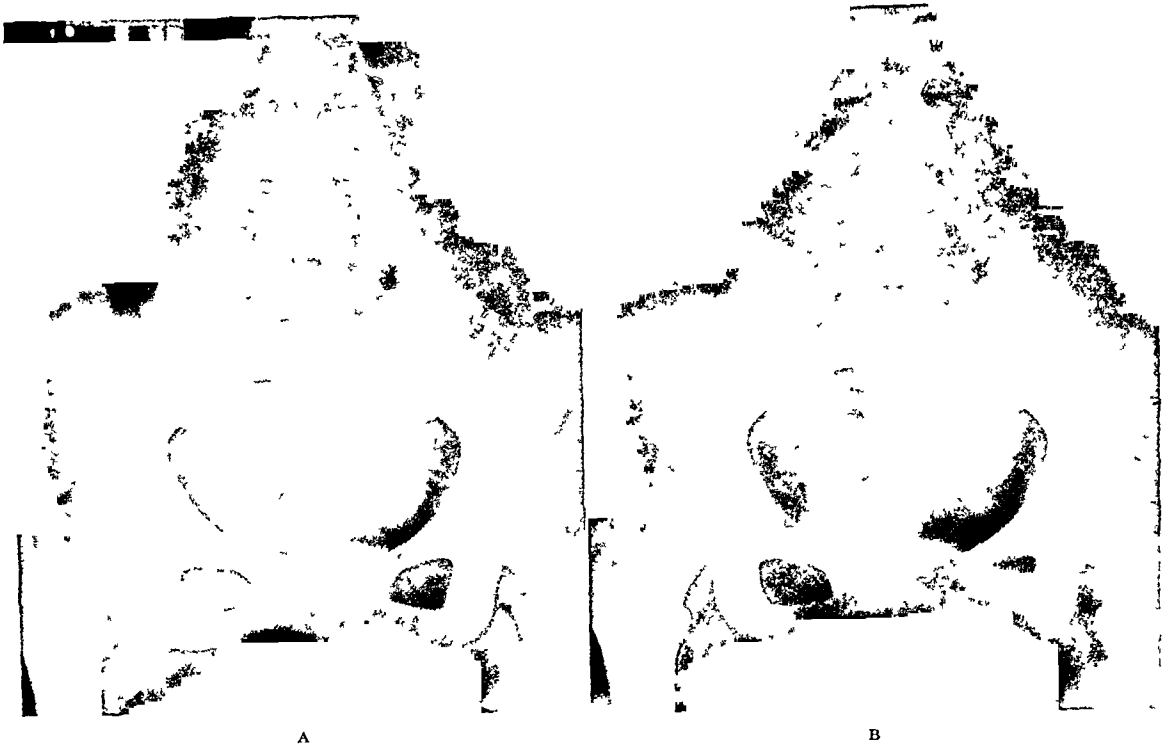
FIG. 2. Intravenous pyelogram illustrating single hypertrophied ectopic left kidney with tortuous ureter. Note the course of the ureter which seems to have its origin at the right border of the region of the third sacral vertebra. The lower pole of the kidney is at the third coccygeal vertebra. Pyelograms of ectopic kidneys are difficult since the dye is excreted so rapidly and the normal technic cannot be followed. A, two minutes after dye injected; B, seven minutes after injection of dye.

pulse 80, respiration 18, temperature 99°F. The eyes appeared normal, there was no diplopia, nystagmus or strabismus; the pupils reacted to light and accommodation. Vision of the right eye was 20/300, of the left 20/200. With lenses this was corrected to 20/70 for the right and 20/60 for the left. Color tests were normal. Visual fields were not done. The vitreous on fundoscopic examination revealed numerous opacities and floaters, and on dilatation of the pupil the retina appeared somewhat reddish. The vessels were thin but not abnormal and the disc was pale and difficult to visualize. There was slight reddening of the nasal mucosa due to a recent upper respiratory infection. The tonsils were enlarged; the thyroid was not palpable. The breasts were full, pendulous and virginal. The lungs were clear and resonant, and the heart had what was thought to be a split systolic at the apex and later at the base, but this was not constant. The abdomen was obese, but otherwise negative; no masses,

imperforate hymen. Absence of the vagina was established by inserting a catheter into the urethra and palpating the thin septum through the rectum. What was interpreted to be the uterus was palpated in the midline. In the left adnexa a non-tender, slightly boggy, smooth mass the size of a grapefruit was felt. This was interpreted to be an ovarian tumor. Laboratory workup revealed negative Wassermann and Kahn serological tests; urine was acid, specific gravity 1.020, negative for albumen and sugar, and two to three pus cells were found per high power field; blood count revealed 5,000,000 erythrocytes, 14.7 Gm. or 88 per cent hemoglobin and 5,900 leucocytes with 70 per cent polymorphonuclears and 30 per cent lymphocytes; the non-protein nitrogen was 35.8 mg. per cent, the upper limits of normal. X-ray of the pituitary revealed a normal sella turcica with no evidence of erosion of the clinoid processes and no calcification or pathological disorder in the calvarium.

Basal metabolic rate was plus 24; this was thought to be increased due to apprehensiveness and a slight elevation of temperature

FIG. 3. View of introitus of reconstructed vagina.

(99°F.) The intravenous pyelogram (Fig. 2) was performed several weeks postoperatively to establish conclusively the absence of the right kidney and illustrate the ectopic pelvic left kidney.

Since the diagnosis was made of an ovarian tumor which was considered to be responsible for her symptoms by a progressive pressure syndrome, it was believed that an exploration with a Baldwin type of vaginal reconstruction would be the simplest procedure. Accordingly, she was prepared for surgery including sulfasuxidine administration and was operated upon August 10, 1945. The vaginal tract was first established according to the technic outlined by Baldwin and the abdomen was then opened. No uterus was present. Its position was occupied by the sigmoid and descending colon displaced to the right by a large retroperitoneal mass in the left pelvis, the size and consistency of a grapefruit. This, on exploring the retroperitoneum, was found to be a hypertrophied kidney. No kidney or ureter was found on the right, and no kidney in its normal location on the left. The right ovary was normal, the size of a golf ball and had a recently ruptured graffian follicle ¼ inch in diameter. The left ovary was elongated and sausage-like of the rodent variety, anterior and lateral to the kidney,

accompanied by a tube adherent along what seemed to be the round ligament margin in the broad ligament. The right tube was similarly present and both ended in the posterior folds of the broad ligament.

All the bowel, including the colon, was high due to a short mesentery. This made the desired loop of ileum somewhat short for drawing into the vaginal tract. However, staggering short horizontal incisions on both leaves of the mesentery provided an adequate means of adding length. There were numerous lymph glands in the mesentery up to 14 mm. in diameter and a specimen biopsied was diagnosed mesenteric lymphadenitis. The appendix was also removed.

The patients postoperative course was complicated by intestinal obstruction due to edema about the anastomosis which was treated with Wangensteen suction and supportive measures, sepsis, due to infection about the new vagina which was treated with penicillin and douches, and an episode of meteorism, due to improper diet which was treated with enemas and a Levine tube. Her lowest red cell count was 3,800,000 with 11.2 Gm. (71 per cent) hemoglobin. This prior to discharge rose to 4,200,000 erythrocytes with 82 per cent hemoglobin. Due to inadequate home facilities she was not discharged from the hospital until October 7, 1945, seven weeks after operation. She was very homesick and refused to eat and her weight on discharge was 118 pounds. Three weeks after discharge, her weight had increased to 126 pounds. The vagina was adequate. (Figs. 3 and 4.)

On analysis, her symptoms could point to an aberrant chronic nephritis, perhaps of the tubular or mixed variety associated with a chronic uremic state due to retention of some toxic substance. The only supporting contention for this is the progressive blindness and the recent transient ankle edema, nocturia, and weight gain, although the latter are not conclusive. Furthermore, this is not excluded by the apparently normal non-protein nitrogen determination, which occurs in chronic tubular nephritis, and normal blood pressure which also occurs here. Again the specific gravity of the urine is fairly high, but no albumin is present.

COMMENT

The importance of removing external stigmas of abnormality in these patients

and thereby permitting adjustment to their deep sense of inferiority, provides them with an opportunity perhaps to enter

to the perineal floor. The intestinal septum was obliterated by a crushing clamp. The criticisms advanced for this method was

FIG. 4. Lipiodal injection of vaginal tract.

matrimony, but essentially to develop normally in the social group. This has been emphasized by Graves[8] and others.[4,5] The choice of a surgical procedure which would be consistent with optimum results including low morbidity and mortality has its advocates.

The operations evolved in artificial vagina are briefly listed. Mackenrodt created a vagina by mucosal transplants. He burrowed between the rectum and urethra and transplanted flaps of vaginal mucosa from other patients. Graves lined the separated pouch with an epithelial surface obtained by turning in flaps from the labia minora and skin from the buttocks. Baldwin created a vagina from the small intestine, if necessary from the sigmoid. The vaginal cavity was first prepared; then the abdomen was opened and a loop of small intestine resected and closed but left attached to the mesentery for blood supply, and the anastomosis completed. The free loop was drawn through the pelvic peritoneum and sutured

that the hazards of surgery were increased by entering the peritoneal cavity and the loop of small intestine continued to secrete. Also the loop retained selective absorption for certain noxious products as bichloride which may be used in douches. Schubert created a vagina from the rectum. The rectum was dissected beginning from the anus, and the coccyx extirpated. The rectum was then severed, the distal end closed and the anal end pushed into the prepared vaginal orifice. The proximal end of the rectum was drawn down through the sphincter and sutured to the skin. This method obviated the previous criticisms. McIndoe and Counseller created a vagina from skin grafts. They implanted and fixed split thickness skin grafts in the prepared vaginal pouch by means of a special torpedo-shaped vaginal mold which was left in place for fourteen days.

As regards prognosis, the condition of single kidney is not a serious menace to life. Collins[3] has shown that of 581 cases of unilateral kidney, 381 or 65 per cent were

adults with an average age of forty years and 68.3 per cent of the patients died of diseases totally unrelated to the genito-urinary system. However, there is a definite hazard to the solitary kidney for it is frequently the site of disease[10] and these patients offer poorer prognosis when genito-urinary tract disease is present. Under the stress of carrying on all the excretory function, the sole kidney may readily become affected by nephritis, calculus or infection as pointed out by numerous authors.[10,15,16] Of series compiled, upwards of 42 per cent of the cases showed lesions of the solitary kidney.[10] Again, these patients do not tolerate extensive surgery on the urinary tract, and in many instances surgical removal of the single kidney has met with inevitable disaster.

Addenda. On November 14, 1945, the non-protein nitrogen was 27.2 mg. per cent, blood pressure was 120/80, and the patient's weight was 124 pounds. Visual examination as reported by the optometrist showed some improvement, correction to 20/60. Before a complete examination could be done by the ophthalmologist, she left town suddenly.

CONCLUSIONS

1. A case of absent uterus, vagina, right kidney and ureter and ectopic pelvic, left kidney is presented. The complaint the patient had was a progressive loss of vision over a four-year period.

2. The embryological process of development of the female genitalia and urinary tract is described.

3. Although absence of the vagina was diagnosed, the remaining anomalies were not discovered until the patient was operated upon. After a somewhat complicated postoperative course, recovery was complete.

4. It is stressed that genital and urinary anomalies occur concomitantly since they have a common embryological origin.

Defects of the genitalia are usually accompanied by anomalies of the urinary system. This does not necessarily follow for defects of the urinary system. Absence of one system of structures should lead to careful investigation and study of the other.

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HEMATOMA OF THE RECTUS ABDOMINIS MUSCLE

REPORT OF A CASE AND ANALYSIS OF 100 CASES FROM THE LITERATURE

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HEMATOMA of the rectus abdominis muscle is a definite clinical entity with more or less constant basic symptoms and physical findings. It was known to the ancient Greek physicians. As recorded by Maydl,[10] Hippocrates made accurate descriptions of this condition; Galen also described it. It is due to a rupture of the fibers of the rectus abdominis muscle or to a tear in one of the epigastric vessels with hemorrhage into the sheath of the rectus muscle. Pain, tenderness, rigidity, and the appearance of an abdominal mass follow. It is of great interest, clinically, because it very closely simulates and is sometimes indistinguishable from acute intra-abdominal conditions. In order to obtain more specific knowledge of this disease, 100 cases (including the case reported here) have been collected from the more recent literature and studied in detail.

CASE REPORT

J. T. W., a white male, age eighty-one, was admitted to the Birmingham Baptist Hospital on the surgical service of Dr. Earle Drennen on March 4, 1940. One day prior to his admission to the hospital he got pain in the left lower quadrant following a slight paroxysm of coughing. Soon after the pain started he noticed a mass in the abdomen. The pain gradually increased in intensity and continued until he was admitted to the hospital. No vomiting, but nausea was present.

He was well developed and well nourished. His temperature was 102°F., pulse 88, and respiration 28. The systolic blood pressure was 155, and the diastolic blood pressure was 90. Examination of the head and neck revealed that there were no abnormal findings present. The heart had a slightly irregular rhythm, occasional extrasystoles being present. The

lungs were resonant and no râles were present. A firm, smooth, and moderately tender mass was felt in the left lower quadrant of the abdomen extending from a little above the level of the umbilicus to the symphysis pubis. This mass was immovable and did not move with the diaphragm on respiration; rigidity of the left rectus muscle was also present.

There was a trace of albumin in the urine, the specific gravity was 1.020, and there were no pus cells, red cells, or casts present. The hemoglobin was 82 per cent, the red blood count was 4,200,000 and the leukocyte count was 15,000 with 83 per cent polymorphonuclear leukocytes.

The diagnosis of an acute surgical condition was made and he was operated upon by Dr. Earle Drennen. Under spinal anesthesia a low left rectus incision was made. When the subcutaneous tissue was severed a dark discoloration was seen as the anterior sheath of the rectus abdominis muscle was approached. The diagnosis of a hematoma in the rectus sheath was made at this point. The rectus sheath was opened and a major portion of the rectus abdominis muscle was found ruptured transversely with the presence of a large hematoma. Upon the evacuation of this clot a large branch of the inferior epigastric artery started to bleed actively. This artery was ligated and the incision closed in layers with drainage. The torn ends of the rectus muscle were very friable and no attempt was made to suture them together. The peritoneum was not opened, for exploration of the peritoneal cavity was not considered indicated.

He had a smooth convalesence, and on March 19th, fifteen days after his operation, he was discharged as cured.

ETIOLOGY

The etiology of this condition is not clear. It occurs rather infrequently in civilian

practice, but in military practice, where men are subjected to training which causes a severe strain on the abdominal muscles, it may be more common. However, the symptoms are milder in young muscular individuals, and the hematoma usually is relatively small.

While it is relatively uncommon in any race, it is extremely rare in the colored race. Only four cases (4 per cent) in this series of 100 cases were reported as having occurred in the colored race.

It occurs much more frequently in women than in men, the ratio is about 3:1. In this series there were seventy-two females and twenty-seven males; in one instance the sex was not given.

Hematoma of the rectus muscle may occur at any age during adult life. The age ranged from seventeen to eighty-three years, while the average age was 46.8 years. Table I gives the distribution of age according to decades.

TABLE I

DISTRIBUTION OF AGE ACCORDING TO DECADES

Age	No of Cases
0 to 10	0
10 to 20	2
20 to 30	12
30 to 40	19
40 to 50	18
50 to 60	13
60 to 70	19
70 to 80	5
80 to 90	2
Age not given	10
Total	100

In 1923, Hilgenreiner[5] classified this condition into two groups, those patients who have normal musculature, and those who have disease of the rectus muscle. He included subgroups under the first class, those due to direct trauma, and those due to indirect trauma. Under the second group he included three subgroups, those occurring during pregnancy or labor, those occurring as the result of disease, and those occurring in elderly individuals.

From an etiologic point of view the types of cases in this series of 100 cases may be divided, most conveniently, into four groups. (Table II.)

TABLE II

CLASSIFICATION ACCORDING TO ETIOLOGY OF CASES OF HEMATOMA OF THE RECTUS ABDOMINIS MUSCLE

	Cases
1. Traumatic	19
(a) Internal violence (16 cases)	
(b) External violence (3 cases)	
2. Cases associated with pregnancy	22
(a) Pregnancy (16 cases)	
(b) Labor (3 cases)	
(c) Puerperium (3 cases)	
3. Cases occurring during the course of a disease.	6
(a) Influenza (5 cases)	
(b) Blood dyscrasia (1 case)	
(c) Typhoid fever (1 case which is included with those cases associated with pregnancy)	
4 Idiopathic	53
Total	100

In the first group those patients are classified who apparently have normal musculature and are otherwise healthy individuals. The occurrence of the rupture of the rectus muscle is due to violence. This may be due to either internal violence caused by muscular exertion as lifting, jumping, etc., or to external violence which is caused by an external force as a blow or a fall on the abdomen. Nineteen cases in this series fall into the first group, sixteen cases of these were due to internal violence and three cases to external violence. Of those cases which were due to internal violence most of them were caused by lifting or jumping, while of those due to external violence, one was caused by a dive into the water and the other two were caused by a kick in the abdomen. Wohlgemuth[15] collected 127 cases from the literature, and a large majority of those cases (107 cases) were traumatic due to internal violence. The majority of the cases due to trauma occurred in young adult males, many of whom were soldiers or athletes. Many cases of this same type were reported by European military surgeons. There also have been reported a number of series of cases (Bowers and Richard, and Fruin and McLaughlin,[1,3]) which occurred among soldiers and sailors in this country during World War II.

In the second group those cases are classified which are associated with pregnancy. Twenty-two cases occurred in this group, sixteen during pregnancy, three during labor, and three during the puerperium. There was a preponderance of cases in the multipara, especially those who have had a large number of children.

The third group constitutes that group of cases occurring during the course of a disease which causes degeneration of the rectus muscle. Five cases occurred during an attack of influenza, and one case had a blood discrasia. Another case occurred during an attack of typhoid fever; this patient was also pregnant and is included with those cases associated with pregnancy.

In the fourth group are those for which there is no apparent cause for a rupture of the rectus muscle to occur. In this group rupture of the rectus muscle usually occurs spontaneously or with slight exertion as coughing or turning in bed. Most of these cases occurred in elderly individuals, although, one case occurred at the age of twenty-eight, and other cases occurred between thirty and forty years of age. Many of these cases are probably due to degenerative changes in the arteries or muscle tissue which are common in advancing age. Fifty-three cases occurred in this group which represents more than half of the total number of cases.

DIAGNOSIS

Hematoma of the rectus abdominis muscle was not frequently diagnosed correctly before operation. In this series only seventeen cases were diagnosed correctly before operation. Culbertson[2] collected forty-one cases from the literature and in only three of those cases was a correct diagnosis made, while in two others it was suspected.

In the differential diagnosis of this condition one must think of both intra-abdominal conditions and lesions of the abdominal wall. Of the lesions of the abdominal wall the most common lesions for which a hematoma might be mistaken were listed by Halperin[4] as irreducible hernia, sarcoma, desmoid, and fibroma and less common ones as gumma of the rectus muscle, actinomycosis, and tuberculosis.

Hematoma of the rectus muscle was variously diagnosed as shown in Table III. It is interesting to note that in those cases which were diagnosed incorrectly only in one case was a diagnosis of a tumor of the abdominal wall made, and in another case one was considered. Five cases were diagnosed as ventral hernia, fifty-five cases were diagnosed as intra-abdominal conditions, while one case was diagnosed as tetanus.

TABLE III

LIST OF DIAGNOSES MADE IN CASES OF HEMATOMA OF THE RECTUS ABDOMINIS MUSCLE

	Cases
Hematoma of the rectus muscle (correctly diagnosed)	17
Ovarian cyst	22
Appendicitis	12
Ventral hernia	5
Intes inal obstruction	3
Gallbladder disease	2
Malignant tumor of the abdomen	2
Ectopic pregnancy	1
Tetanus	1
Desmoid tumor	1
Hydronephrosis	1
Twin pregnancy	1
Miscellaneous conditions	12
Diagnosis not given	20
Total	100

While the diagnosis of this condition in most cases is not extremely difficult, the error in diagnosis is usually due to the fact that the condition is not kept in mind and given proper consideration in the differential diagnosis. In some cases, however, it is most difficult to differentiate it from intra-abdominal conditions.

A careful history is essential in making a correct diagnosis. The most common story was that the patient had a paroxysm of coughing following which he experienced a severe pain in the abdomen. Patients with abdominal pain following exertion or injury of the abdominal wall, regardless of how trifling it may have been, must be suspected of the possibility of having a hematoma of the rectus muscle, particularly if there is a

mass present. Occasionally the mass was noted to steadily increase in size. A number of patients complained of having a sensation as if something tore in the abdomen.

Seventy-eight patients in this series had a palpable mass present. The mass does not move up and down with respiration, and when the abdominal muscles are contracted as in raising the head the tumor may become more prominent, and also becomes fixed while previously one may have been able to move it slightly from side to side. In a few cases a groove was palpable which apparently was the space between the retracted ends of the ruptured muscle.

Forty-nine patients had definite abdominal rigidity which was either localized to the quadrant where the lesion was located or involved the entire affected side of the rectus muscle, although, in some cases there was generalized abdominal rigidity present. Seventy-one patients had tenderness present; this also was either localized or generalized; twenty-three patients had nausea and only fifteen had vomiting.

The most common symptom was pain, it was reported present in all cases except three, and one of those patients was comatose during the onset of the condition. The pain ranged all the way from a mild and dull pain to a very severe and sharp pain. In some cases the pain was generalized, but in others it was localized to the lesion.

Many patients had an expression of being in distress and appeared acutely ill. In many patients there was a weak, rapid pulse with pallor and a cold perspiration or other signs of shock depending upon how much loss of blood there was into the rectus sheath. Some patients moved with extreme caution and protected the abdominal muscles. Breathing was more thoracic in type, particularly when asked to take a deep breath they guarded against using the abdominal muscles.

In nearly all cases, in which the blood count was reported, there was an increase in leukocytes; the average leukocyte count was 11,600, while the highest count observed in any case was 18,600 with 78 per cent polymorphonuclears. Platelet count, bleeding time, and coagulation time were in all cases, when reported, within normal limits. The temperature ranged from 97° to 102°F., the average was 99.5°F. The average systolic blood pressure was 154, and the average diastolic blood pressure was 88. The highest systolic blood pressure reported in any patient was 232, and the highest diastolic blood pressure reported was 132. The blood pressure is probably the same as that of the average group of patients in this age group.

Ecchymosis was observed in a number of patients, but it usually was a rather late sign, and therefore of only limited diagnostic value. It was observed in twenty-one patients in this series; the average time between the onset of symptoms and the appearance of the discoloration was four days, although, in a few cases the ecchymosis was present when the patient was first seen. In one case the discoloration first appeared on the tenth day following the onset of the symptoms. In one case the discoloration occurred on the scrotum and in two cases it occurred on the labia majora. In the case in which the scrotum was involved and in one of the cases in which the labia majora was involved the discoloration occurred only on that side of the middle line on which the hematoma was located.

ANATOMIC CONSIDERATIONS

There are certain points in the anatomy of the abdominal wall which deserve special consideration. The rectus muscle is covered anteriorly by a strong fibrous sheath on its entire length. Posteriorly there is a fibrous sheath present only on its upper two-thirds, while on its lower third, the area below the linea semicircularis (fold of Douglas), there is no fibrous sheath present. This anatomic arrangement is significant for a hematoma occurring in the lower third of the rectus muscle may dissect laterally between the aponeurosis of the transversus abdominis and the transversalis fascia which covers the peritoneum. Likewise it is anatomically possible for a hematoma to cross the mid-

line below the linea semicircularis, for in this portion there is no dense fibrous tissue between the right and left recti as there is in the linea alba in the upper part of the abdomen. On the other hand a hematoma occurring above the linea semicircularis is definitely limited laterally and at the midline by the strong fibrous union of the rectus sheath and the aponeuroses of the external oblique, internal oblique, and transversus, both in the midline and the lateral margin of the rectus. However, a hematoma in the upper part of the rectus muscle may extend downward in the sheath of the rectus to below the linea semicircularis.

Wickliffe[14] reported a case in which a hematoma below the linea semicircularis had dissected laterally beyond the edge of the rectus muscle. In two cases, reported by Perman and Zohman,[11,16] the hematoma had extended downward into the prevesical space (of Ritzius) from the rectus muscle; and in one case, reported by Hobbs,[6] the hematoma extended the entire length of the right rectus muscle from the symphysis to the costal margin. In the case reported by Zohman[16] the entire left rectus muscle was involved.

Since there is no fibrous sheath posteriorly in the lower third of the rectus muscle a large hematoma in this region exerts direct pressure against the transversalis fascia and the peritoneum. In one case, reported by Toft,[12] the hematoma of the rectus muscle had perforated the transversalis fascia and the peritoneum and a large amount of blood escaped into the peritoneal cavity from the hematoma.

The most common site for the occurrence of a hematoma was the right lower rectus, for in approximately half of the cases the lesion was located at this site. The order of frequency of the location of the hematoma in the rest of the cases was the left lower, right upper, and left upper rectus (Table IV); and in most cases the mass did not extend beyond the midline or the lateral margin of the rectus. In two cases the hematoma had involved the entire sheath

of the rectus, while in three cases, reported by Lichenstein, Perman, and Vogt,[7,11,13] the condition occurred bilaterally. Of these three cases, the patient reported by Vogt,[13] had two separate hematomas present, while in the other two cases it was

TABLE IV
LOCATION OF THE HEMATOMA IN THE RECTUS SHEATH

	Cases
Right lower	49
Left lower	22
Right upper	9
Left upper	7
Right upper and lower	1
Left upper and lower	1
Bilateral	3
Location not given	8
Total	100

not certain whether the hemorrhage occurred on both sides of the linea alba or whether the hemorrhage occurred on only one side and then extended across the midline over to the other side.

TREATMENT

Operative treatment is indicated in most cases of hemorrhage into the abdominal wall. The earlier such treatment is instituted the more favorable will be the outcome, for delay may cause an increase in the extravasation of blood and an extension of the hematoma. However, young and vigorous individuals with a small hematoma may be treated conservatively with the application of an ice bag, rest in bed, and the use of sedatives; and later when the danger of further hemorrhage is over, hot compresses or a hot water bottle may be used instead of an ice bag. Patients in whom the rupture of the muscle is due to trauma, and in whom the muscle and arteries are apparently normal, usually recover promptly with conservative treatment. Evidence of a repeated hemorrhage or the formation of an abscess, however, constitutes an indication for operative intervention. In cases in which the diagnosis is not clear, an exploratory operation is a safe procedure to clear up the diagnosis and also to treat the condition as suggested by Halperin.[4]

Eighty-five patients in this series were operated upon, while in fourteen cases no operation was done. Of these fourteen one patient died before an operation could be done; the other patients were treated conservatively with good results in each case. In one case the method of treatment was not given.

Fruin and McLaughlin[3] reported fifty-one cases of rectus muscle strain, and Bowers and Richard[1] reported eight cases. In both of their series all the cases occurred in apparently healthy individuals who were undergoing severe physical exertion in military training. All their cases were due to trauma and all the patients were treated conservatively with recovery in each case.

Elderly individuals with disease of the muscle or arteriosclerosis of the vessels may have repeated or continuous hemorrhage into the abdominal wall and require ligation of the ruptured vessel. In this series there were a number of cases in which 500 cc. or more of blood or clots were removed from the rectus sheath. In one case, reported by Wickliffe,[14] 2,000 cc. of clotted blood were removed while in another case, reported by Hobbs,[6] which ended fatally 1,500 cc. of blood and clots were removed.

The incision should be made directly over the mass and the clot or extravasated blood evacuated and the bleeding vessels ligated. If the hematoma has not extended through the peritoneum into the abdominal cavity, and there is no indication for exploration of the abdominal viscera, the peritoneal cavity need not be opened. If the wound is dry and no infection is present, closure may be done without drainage; but if there is much oozing of blood from the torn ends of the muscle tissue, as is frequently the case, it is best to drain the wound.

PROGNOSIS

The prognosis of this condition is generally favorable, but it carries with it a certain mortality especially in elderly and debilitated individuals. In this series of 100 cases four patients died. In the first case, reported by Hobbs,[6] there was profuse hemorrhage into the rectus sheath, and the patient died of shock before a transfusion could be given or the patient operated upon. In the second case, reported by MacLennan,[8] the patient died on the fourth day after operation, and autopsy revealed a recurrence of the hemorrhage into the rectus sheath and a very friable myocardium with general arteriosclerosis. The third patient, reported by Perman,[11] died of pneumonia with lung abscess, although, no infection occurred in the operative wound through which the hematoma was removed. The patient in the fourth case, reported by Malpas,[9] died of a concurrent gastric hemorrhage four days after operation.

SUMMARY

A case of hematoma of the rectus abdominis muscle is reported, and a series of 100 cases (including the case reported here) have been collected from the more recent literature and studied in detail. From the data of these cases the following summarizations are made:

1. It is a rare occurrence in the colored race; only four cases out of a series of 100 have been reported as having occurred in the colored race.

2. It occurs about three times more frequently in women than in men.

3. Cases have been reported which ranged in age from seventeen to eighty-three years, while the average age of the group was 46.8 years.

4. From an etiologic point of view the cases of hematoma of the rectus muscle may be classified into four groups, (1) traumatic, (2) cases associated with pregnancy, (3) cases occurring during the course of a disease, and (4) idiopathic.

5. Only seventeen cases in this series were correctly diagnosed before operation; twenty-two cases were diagnosed as ovarian cyst, twelve cases as appendicitis, and five cases as ventral hernia.

6. Fewer errors in diagnosis would be made if this condition were kept in mind

and given proper consideration in the differential diagnosis.

7. The most common symptom is pain, it was present in all except three cases. A palpable mass was present in seventy-eight cases, tenderness in seventy-one cases, rigidity in forty-nine cases, nausea in twenty-three cases, and vomiting in fifteen cases.

8. The average white blood count in this series was 11,600, and the average temperature was 99.5°F.

9. Ecchymosis is a helpful diagnostic sign when present, but it occurs too late to aid in the early diagnosis. It occurred in 21 per cent of the cases, but first appeared on the average of four days following the onset of symptoms.

10. Most cases should be treated promptly, surgically, but traumatic cases in young individuals with healthy musculature of the rectus muscle and a small hematoma do very well with conservative treatment.

11. Hematoma of the rectus muscle carries a mortality of 4 per cent.

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ADENOCARCINOMA OF THE COMMON BILE DUCT WITH RESECTION, ANASTOMOSIS OF THE HEPATIC DUCT TO THE CYSTIC DUCT AND CHOLECYSTOGASTROSTOMY*

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A CASE of papillary adenocarcinoma of the common bile duct is presented with resection of the growth, anastomosis of the common hepatic duct to the cystic duct and establishment, with a cholecystogastrostomy, of continuity with the gastrointestinal tract. A short review of the literature is also presented. In this study, cancer of the ampulla of Vater is not considered.

Carcinoma of the extrahepatic bile ducts differs in many respects from the more common carcinoma of the gallbladder. "The relative infrequency of gall stones (22 per cent in 264 cases) and the predominance of the disease in males 50/35 contrast carcinoma of the larger bile passages with that of the gall-bladder."[1]

Although carcinoma of the extrahepatic bile ducts is considered quite rare by most observers, a review of 46,442 autopsies[2-6] reveals 123 cases of primary cancer in the extrahepatic bile ducts. This gross incidence of .26 per cent means that this disease was found in about one out of every four hundred patients coming to autopsy in this series. Palnar reported 103 cases of cancer in the biliary passages in over 53,000 necropsies—0.19 per cent of all autopsies or 2.2 per cent of all carcinomas found.[7] An analysis of the literature indicates that the most common site for cancer of the extrahepatic ducts (exclusive of the ampulla of Vater) is the confluence of the cystic, common hepatic and common bile ducts. Cancer of the common bile duct occurs primarily past middle age (fifty to seventy). In many of the cases there is associated biliary tract disease: cholecystitis, cholangitis, cirrhosis, or stones.

"Although primary carcinoma of the common bile duct is comparatively a rare pathological entity, it should be given consideration as a possible cause of persistent obstructive jaundice in all cases occurring past middle age."[8]

Carcinoma of the extrahepatic bile ducts is of three types according to Ewing: diffuse, nodular and villous. Usually the villous or papillary type of growth attains the largest size without severe obstructive symptoms, is of lowest degree of malignancy and is most amenable to surgical management. Metastasis from carcinoma of the bile ducts is not common[9] and occurs late. In Marshall's series of forty-nine cases, only twelve showed metastasis—nine to liver, five to regional lymph nodes, three to pancreas and one to the lungs.

Marshall, in speculating on causes of malignancy of the extrahepatic ducts, noted that if stones were the principal etiological factor, this disease should be more common in women than in men, but as already mentioned, the opposite is the case. Dick suggested that cancer of the common bile duct might be due to long continued application of a carcinogenic agent acting on an hereditarily susceptible person. He postulated that cholic acid, which is related chemically to known carcinogenic substances, might be this etiological factor.[4]

The symptoms and signs of cancer of the extrahepatic bile tracts are those of obstructive biliary disease and of malignancy. Among the early symptoms are vague gastric distress, lassitude and fatigue, loss of appetite and loss of weight. Jaundice

may come early or late and may be persistent or intermittent depending upon the type and the location of the growth. Colic,

Bile Ducts. Resection of the affected portions has been done with either end-to-end[10] anastomosis over a T or vitallium
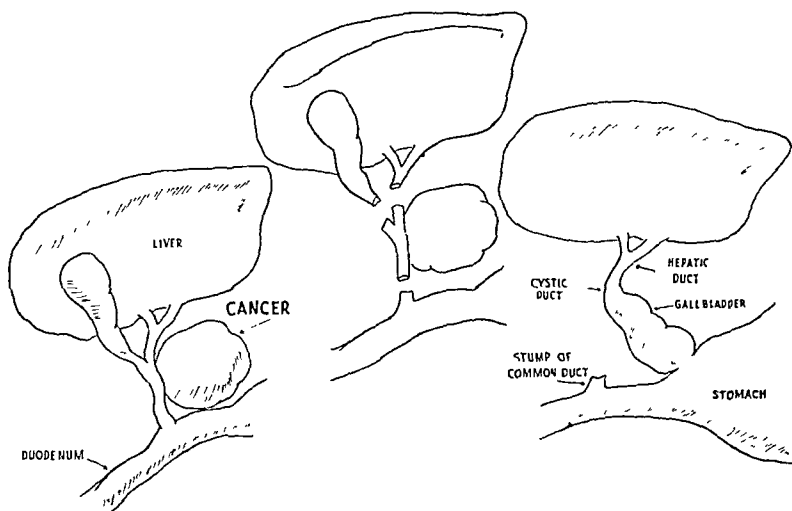
FIG. 1. Diagrammatic sketch illustrating the technical features involved in the surgical procedure.

chills and fever may be late symptoms. Spontaneous hemorrhage is seen in about one-third of the cases.[9]

Carcinoma of the extrahepatic ducts can rarely, if ever, be diagnosed with certainty during life without surgical exploration. In any differential diagnosis of obstructive biliary tract disease, however, cancer of the extrahepatic ducts should be considered. According to Lee and Totten, early diagnosis and surgery in this disease tends to lower mortality by (1) minimizing extension of the carcinoma, and (2) preventing complications due to hemorrhage, hepatic insufficiency and cholemia.[8] Since surgical resection of the neoplasm obviously offers the only chance for cure of this disease, we will not consider palliative procedures here.

In a consideration of the surgical treatment of cancer of the supraduodenal portion of the duct system, the site of the lesion and the type of growth[5] determine the procedure that can be attempted in each case. Beginning at the hepatic ducts and passing distally, the following types of operations have been performed.

Carcinoma of the Hepatic Duct or the Juncture of the Hepatic, Cystic and Common

tube,[11] or hepaticoduodenostomy.[12] Resection with anastomosis of the remaining part of the hepatic duct into the remaining part of the cystic duct with cholecystogastrostomy, as in this case report, can be used. Obviously such procedures as cholecystotomy, cholecystogastrostomy alone or choledochostomy have little to offer.

Carcinoma of Cystic Duct. Cholecystectomy with wide removal of the cystic duct will be successful in a comparatively large number of cases, provided the growth is small and metastases have not developed at the time of operation.

Carcinoma of Common Bile Duct. Resection with hepaticoduodenostomy[13] or with end-to-end anastomosis has been suggested. Two-stage procedures, similar to those preformed by Whipple, Parsons and Mullins[14] for cancer of the ampulla of Vater and similar to those suggested by Brunschwig[15] for cancer of the head of the pancreas, seem feasible in these cases. Cholecystoenterostomy and gastroenterostomy could be done at the first stage and resection at a later date when the patient's condition has improved.

Best and Hicken,[16] in a review of 221 cases of biliary intestinal anastomosis,

reported a surgical mortality of 41.1 per cent.

CASE REPORT

Mrs. A. C., housewife, age fifty years, married, mother of one child, presented herself at the Clinic for the first time January 11, 1943, complaining of jaundice, dyspepsia, loss of weight, fatigue and pain in the epigastrium. The only pertinent fact from her family history was that her father had died following a gallbladder operation at the age of sixty-three years. The patient passed the climacteric at 43 years, had scarlet fever (age thirteen years) and typhoid at the age of six. At the age of twenty-three an appendectomy and a right oöphorectomy were performed on this patient. The jaundice, dyspepsia and epigastric distress had come on gradually.

In August, 1941, the patient was jaundiced and was under medical management for about two months. In December, 1941, after cleaning a rabbit, Mrs. A. C. developed tularemia and was in bed until February, 1942. She gradually increased in strength until September, 1942, when she had colicky pain in the right upper quadrant of the abdomen, without chills or fever, but with recurrence of the jaundice. Again she lost weight (112 to 108 pounds). There was nausea but no qualitative food distress.

Physical examination on the first visit revealed a slender woman, 55 inches tall, weighing 105 pounds, with definite icteric tint to her skin and sclera. Blood pressure was 130/90; pulse 96; temperature 98°F. Salient features of the physical examination were scars of a previous laparotomy, a tender palpable liver extending 3 to 4 inches below the right costal margin and enlarged lymph nodes in the left axilla and near the left elbow (tularemia).

Rectal, vaginal and neurological examinations were uninformative.

Laboratory Data: Urine negative; blood urea 44.5; blood sugar 110; icterus index 20. The Van den Bergh revealed an immediate direct positive reaction. Hemoglobin 77 per cent (photelometer); red blood count 3.87 million; white blood count 9100 (polymorphonuclear leucocytes 56 per cent; lymphocytes 43 per cent; basophilic leucocytes 1 per cent).

Roentgenograms revealed a non-functioning gallbladder and a low lying atonic stomach somewhat displaced to the left. Barium enema was uninformative. Tentative diagnosis was made of obstructive jaundice of unknown cause with a non-functioning gallbladder and a secondary anemia. It was decided to try medical management.

Her condition varied with relapses and remissions until November 28, 1943, when she was admitted to the Clinic Hospital with severe biliary colic requiring morphine hypodermically for relief. There were neither chills nor fever. The icterus index, on this admission, was 14 and the hemoglobin was 85 per cent (photelometer). Exploration was urged but the patient demurred and left the hospital in a week, relieved of pain.

She was readmitted March 19, 1944, complaining of recurring attacks of gallbladder colic. The pertinent laboratory data were as follows: Hemoglobin 76 per cent (photelometer); red blood count 4.15 million; white blood count 10,900; prothrombin time 91 per cent; icterus index 14. Urine was essentially normal. Physical findings were as before. She was offered and accepted an exploratory operation which was performed March 21, 1944, at the Clinic Hospital.

Operation was performed under cyclopropane anesthesia. A high right rectus incision was made. Examination revealed a slightly enlarged uterus which was freely movable. A left ovary was found; no right ovary was present (apparently long since removed). The appendix had also been removed. The gallbladder wall was slightly thickened. The liver came three fingers below the costal margin and the veins in the round ligament were quite enlarged. There was a cystic tumor, approximately 8 cm. in diameter, above the lesser curvature of the stomach, under the left lobe of the liver. This tumor seemed to arise from the pancreas. A needle inserted in this tumor yielded a thick mucoid material but no bile. A biopsy removed revealed a papillary adenocarcinoma in fresh frozen sections.

It was assumed that this was a resectable tumor arising from the pancreas. A resection was started and severe bleeding was occasionally encountered. Attempts were made to find the common bile duct by following the cystic duct distally but this became especially difficult; apparently the cystic duct ran into the tumor or was compressed by the tumor. As the dissection proceeded, a sector was cut off which

proved to be a duct and which exuded bile. Bile began to run out of the tumor.

Careful exploration revealed that the tumor

FIG. 2. Gross specimen showing the size of the tumor.

arose in and involved the common duct. The lesion was dissected upward and the hepatic duct was cut off just distal to its bifurcation. This duct was greatly dilated and fragments of the tumor were aspirated by suction tip out of the hepatic ducts. There was now a space approximately 4 cm. long where the common duct had been removed. (Fig. 1.)

The problem was to get the bile into the gastrointestinal tract. The cystic duct was split up a centimeter or two, in order to provide a caliber equal to that of the hepatic duct. The cystic duct was anastomosed to the hepatic duct using No. o chromic interrupted sutures on an atraumatic needle. A small catheter was inserted from the liver through the stump of the hepatic duct up through the gallbladder and out of the fundus. The gallbladder was then attached to the anterior surface of the stomach in an ordinary cholecystogastrostomy. (Fig. 1.) Five Gm. of sulfanilamide were poured into the peritoneal cavity and a penrose drain was placed down to the anastomosis. Two plasma units were given during the procedure to combat shock.

The patient's condition on leaving the table was satisfactory. Risk of operation was 3 because of the cirrhosis, the neoplasm and the

FIG. 3. Illustrates the microscopic architecture of the tumor. × 20.

extensive operative procedure· which lasted about three hours.

Tissue removed consisted of a portion of the common bile duct with the tumor which measured 9 by 6 by 4 cm. in its greatest dimensions. (Fig. 2.) Microscopic examination revealed a papillary adenocarcinoma grade 2. (Figs. 3 and 4.)

Postoperatively the first few days were uneventful. The highest rise in temperature was to 102.4°F. Bile drained from the catheter and the wound. On the eighth postoperative day the catheter came out and the bile continued to drain from the wound. On the ninth postoperative day the patient had severe colicky pain in the abdomen associated with symptoms of shock; at this time fluid blood drained through the abdominal wound. The prothrombin time was 85 per cent; icteric index 12; hemoglobin 75 per cent; red blood count 3.70 million. Two plasma transfusions were given.

The following day the patient improved and on the twelfth day she seemed much improved. On the twenty-first day the patient vomited bright red blood. Blood also drained from the wound on the twenty-first day and there was considerable pain in the abdomen. Hemoglobin was 78 per cent; red blood count 3.88 million; white blood count 8,650; icteric index 10. Two more plasma transfusions were given, but in spite of all restorative efforts, bleeding continued from the wound and the patient died on the twenty-second postoperative day.

On April 13, 1944, the postmortem examination, which was limited to the abdomen, revealed a fistulous tract leading down to the fundus of the gallbladder from which bile

Anatomic Diagnosis: Recent postoperative hemorrhage into the biliary tract; acute hepatitis on a chronic hepatitis; biliary cirrhosis of the liver.

FIG. 4. Reveals cellular detail of the neoplasm. × 100.

exuded. This was apparently the hole in the fundus where the catheter had been brought outside. There was dark blood in the stomach. There was no peritonitis nor any gross change of the lining of the stomach except for the staining by the old blood.

The anastomosis between the gallbladder and the stomach was intact and there was no evidence of leakage. The gallbladder was dissected away from the liver; the anastomosis between the cystic duct and the hepatic duct was intact. However, in this space at the porta hepatis where the anastomosis was made, there had been a hemorrhage apparently from a small vessel, a branch of the hepatic artery or vein or both and this hemorrhage filled the space formerly occupied by the carcinoma of the common duct.

The liver was enlarged, as was noticed at the time of the operation. There were pale yellow patches in the liver. Apparently there had been an acute hepatitis on a chronic hepatitis and biliary cirrhosis of the liver. Lymph nodes around the common duct were greatly enlarged. No other gross changes were found.

Microscopic examination of liver sections revealed a biliary cirrhosis. The lymph nodes near the liver revealed no metastasis.

COMMENT

Carcinoma of the extrahepatic bile passages must be considered in the differential diagnosis of any obstructive jaundice, particularly if there is an associated fatigue and weight loss in a person of middle age or beyond. If in such a condition, definite improvement is not obtained after a short term of medical management, early surgical exploration is indicated.

Resection of a neoplasm of the common bile duct offers the only hope for cure, but the resectibility of the growth depends on the condition of the patient, the location, size, type and extension of the tumor and the feasibility of connecting the biliary and gastrointestinal tracts.

The act of restoring the continuity between these tracts is many times a difficult surgical feat and its accomplishment re-

quires ingenuity and resourcefulness in each instance. The use of the gallbladder and cystic duct as a connection between the hepatic duct and stomach was the solution to that problem in this case.

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CONVULSIONS DURING ANESTHESIA TREATED WITH INTRAVENOUS SODIUM PENTOTHAL*

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THE appearance of convulsions during an operative procedure is always a distressing and alarming occurrence.

FIG. 1. Anesthesia record.

In the past it has always been the signal for hurried conclusion of the procedure and the removal of the patient to his room where the treatment consisted mostly of supportive measures. Now that an effective method of controlling the convulsions is available, it is no longer necessary to interrupt the operation which can be continued to its predetermined conclusion.

Preventive measures cannot be taken since the etiologic factors have not yet been definitely proven. Each author has proposed as the causative factor the singular feature of his case so that thus far more than thirty possible etiologic agents have been propounded (Lundy).[1] Anoxia is definitely a cause as convulsive movements are frequently seen when nitrous oxide is given in too high concentrations, but convulsions have also occurred with ether and cyclopropane when very high concentrations of oxygen are being inhaled and anoxia was apparently not a factor. Recently Rosenow[2,3] has suggested that the convulsions may be due to a neurotoxin from a neurotrophic streptococcus, but as yet this has not been proven in controlled experiments.

The treatment has been varied with the many authors and has included a wide variety of measures. The method of choice recommended by most is the immediate intravenous administration of sodium pentothal in amounts sufficient to control the convulsion along with the inhalation of high concentrations of oxygen. A search of the literature has not revealed any

cases of convulsions under cyclopropane and oxygen anesthesia in which these measures were immediately used.

The following case is being presented as an example of one in which the diagnosis was made early, and effective treatment with sodium pentothal was immediately started:

CASE REPORT

O. H., a thirty-five year old, emaciated, pale, white male was admitted with a large mass in the left lower quadrant, abdominal pain, marked weight loss and extreme weakness. Two years previously, in another hospital, he had had an ileosigmoidostomy performed for what was thought to be an inoperable carcinoma of the descending colon.

The patient was given strong supportive treatment, multiple transfusions and high vitamin régimé and prepared for an exploratory operation. It was believed that this large mass, which was very painful, might be removed, and some palliation gained. At operation, a large tumor mass was found in the descending colon and sigmoid above the functioning ileosigmoidostomy. A loop of ileum running through the tumor was divided, and an entero-enterostomy done. The tumor mass was freed with difficulty and removed, the proximal colon closed, and the ileosigmoidostomy not disturbed. The patient was returned to his room, where he had a satisfactory postoperative course.

The anesthesia record is of interest. Preoperative medication of morphine sulfate gr. ⅙ and atropine sulfate gr. ⅟₁₅₀ was given hypodermically at 7:45 A.M. Anesthesia with cyclopropane and oxygen was begun at 8:05 A.M. and the incision made at 8:15 A.M. Intravenous fluids were then started, and during the procedure the patient received 1,000 cc. of saline and 1,000 cc. of whole blood. The anesthesia proceeded well with no untoward signs until at 11 o'clock, almost three hours after the start of anesthesia, twitching of the muscles of the face was noted under the hand of the anesthetist holding the mask. About one-half minute later, spasms of the muscles of the arm in which the infusion was running were noted, and diagnosis of convulsions under anesthesia then made. An ampule of sodium pentothal, which was on the anesthesia table in the operating room, was then opened, dissolved, dumped into the infusion and rapidly administered. Less than two minutes had elapsed since the muscle spasms had been first noted in the face, but the convulsions had spread to the legs and become generalized. In about thirty seconds after the start of the administration of sodium pentothal, when about 0.2 Gm. had been given, the spasms completely disappeared.

The pulse rate and blood pressure, which were not determined during the seizure, were now at their preconvulsive level, and the operation proceeded to its predetermined conclusion thirty minutes later at 11:35 A.M. The remainder of the Gm. of sodium pentothal, which was still in the infusion, was allowed to run in slowly during the conclusion of the operation and in the first postoperative hour. The patient had fully reacted at 1 P.M. with no signs of central disturbances. He then went on to a completely uneventful recovery with no sequelae of any kind. When seen six months later, he was feeling fine, had gained 10 pounds, and there were no signs of any cerebral damage.

COMMENTS

Anoxia, which may be a cause of convulsions through the production of cerebral edema, was apparently not involved. The patient received at least from 50 to 80 per cent oxygen during the entire procedure, his color was pink, and there was an ample respiratory exchange. A closed system machine with a double soda lime chamber for absorption of carbon dioxide, in which the cannister had been refilled immediately prior to the start of anesthesia, was used. There were no abnormalities in the position of the patient, who was supine and in about 10 degrees Trendelenburg. His temperature was not markedly elevated or the room exceptionally hot.

The treatment of convulsions during anesthesia is the administration of drugs which directly depress the responsible brain centers. The desired result is the immediate suppression of the symptoms in a manner which will not have any harmful sequelae for the patient. The administration of

sodium pentothal intravenously seems to be the method of choice, since as was demonstrated in the above case, the symptoms stopped immediately, the surgeon was allowed to finish the operation and the patient had no sequelae.

The author wishes to express his thanks to Dr. Carl Eggers for permission to use his case in this report.

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CARCINOMA of the face, mouth, tongue, and nasal sinuses may result in severe pain entirely in the distribution of the trigeminal nerve, but usually the pain extends into the sensory domains of other nerves, especially the ninth and upper cervicals. In such cases fifth-nerve section should be combined with section of one or more of the other nerves mentioned.

From "Surgical Treatment of the Nervous System" edited by Frederic W. Bancroft & Cobb Pilcher (J. B. Lippincott Company).

SURGICAL IMPORTANCE OF CARCINOID TUMORS OF THE ILEUM

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CARCINOID tumors enjoy the unique distinction of being classed with the benign tumors,[1,2] and yet are capable of metastasizing to the regional lymph nodes and the liver. Although metastasis of a carcinoid of the appendix is rather uncommon, the same cannot be said for this tumor when it is found in the ileum. In the cases reported to date, the incidence of metastasis of carcinoid of the ileum varies from 18.3 per cent[3] to 52 per cent.[4] In addition to this potentiality to metastasize, carcinoid of the ileum also quite commonly produces intestinal obstruction.[5,6] Here then, the surgeon is confronted by the paradox of a tumor classed with the benign tumors, and yet having the ability to metastasize or produce death by intestinal obstruction. The answer must lie in the fact that many carcinoids of the ileum, particularly the small ones, apparently are asymptomatic and are discovered by accident during operation or necropsy. In many cases, small carcinoids of the ileum lead to a symptom complex highly suggestive of recurrent appendicitis. It is very likely that many such patients are operated upon for appendicitis and that the true nature of the disorder is not recognized if a "button-hole" incision is made and an appendectomy done without examination of the ileum. Our Case 1 was of this type, but a diagnosis was made at the time of operation because an adequate incision was made so that satisfactory examination of the abdominal contents could be done.

Because of this potentiality of carcinoids to metastasize and to produce bowel obstruction, we believe that even when the tumors are small, a resection of the bowel is the treatment of choice. It must also be remembered that carcinoids of the ileum are not infrequently multiple (Case 1), so that the bowel resected should be at least six inches from the tumor found. It is further very important that all of the ileum be examined to be certain that other foci of carcinoid growth are not present before the resection is begun.

CASE REPORTS

CASE 1. C. Y., a fifty-eight year old white male, was admitted to the Grace Hospital on January 26, 1945, with a diagnosis of undulant fever and recurrent appendicitis. He had had recurrent attacks of pain in the lower right quadrant associated with nausea and vomiting. These attacks had occurred at varying intervals of time during the past four years, but recently the intervals had become shorter and the attacks of pain more severe. Between attacks his appetite was good. There were no clay, tarry or bloody stools at any time, and no constipation or diarrhea. The only positive finding in his past history was the note that as a result of an infection with the brucella mellitensis, he would suffer from periodic attacks of chills, fever (102° 104°F.), aches and pains in bones and joints and fatigability. On physical examination, a middle aged white male lying comfortably in bed was noted. He did not appear to be acutely ill. Head, ears, eyes, nose, and throat examinations showed no pathological disorder. The heart was normal in size and position and there were no murmurs. Blood pressure was 120/70; pulses equal and regular; there was no pulse deficite. Lung expansion was equal; there was no dullness to percussion; the tactile fremitus was normal. Voice sounds were normal, but there were coarse rhonchi over the large bronchi. In the left breast a soft, well circumscribed and moveable tumor, having all the gross characteristics of a lipoma, was found. There were no masses palpable in the abdomen. There was slight tenderness in the lower left quadrant but no rebound tenderness or psoas muscle spasm.

The electrocardiogram revealed occasional auricular extra-systoles. (Dr. Colvin.) Roentgenograms of the chest revealed moderate

FIG. 1. Note the invasion of the bowel wall by the carcinoid. The cells are arranged in small masses. × 125.

generalized chronic diffuse non-specific bronchitis associated with enlargement of the hilar mediastinal lymph glands bilaterally. Several calcifying foci were seen at and about both hilar areas. This was evidence of healed primary tuberculous pathology. There was bifurcation of the anterior end of the fifth rib on the left (anomaly), but no evidence of active pulmonary tuberculosis, lobar pneumonia or cardiovascular disease. (Dr. Rowland.)

A flat plate of the urinary tract was not entirely satisfactory due to the large amounts of gas and fecal material remaining within the large and small intestine. Neither kidney outline was seen to satisfaction. Both psoas muscles, however, were visualized and appeared to be normal. Skeletal structures reviewed appear to be well within the range of normal. (Dr. Rowland.)

The Kahn test was negative. Agglutination test for typhoid, para-typhoid, and malta fever was also negative. Prothrombin time was 100 per cent; blood sugar: 90 mg. now protein nitrogen 36 mg; whole blood chlorides 477 mg; serum albumin: 3.4; serum globulin: 2.3; total protein: 5.7.

Blood examination revealed hemoglobin 15 Gm. (90 per cent); red blood cells, 4,790,000; white blood cells, 8,900; polymorphonuclears 55 per cent; filaments 51 per cent; non-filaments 4 per cent; eosinophiles 4 per cent; baso-

philes 1 per cent; lymphocytes 40 per cent; basal metabolic rate plus 7 per cent. The urine was yellow, clear and alkaline; specific

FIG. 2. Note that the tumor cells are arranged in masses. There is no extensive spread of the tumor through the bowel wall. × 100.

gravity 1.018; albumin: negative; sugar: negative; sediment: negative.

On January 18, 1945, under cyclopropane anesthesia, a mid-right rectus incision was made, the rectus muscle was retracted toward the mid-line, and the abdomen opened. The upper abdomen was examined. The stomach and duodenum were normal. A few fine adhesions were found between the gallbladder and the omentum. These were separated and the gallbladder was found to be normal in size. There were no stones and it emptied readily. The liver appeared to be normal grossly. The colon was palpated throughout. It was normal to palpation. The small intestine was examined and was found to be normal throughout except for an area twenty inches above the ileocecal valve. Here a nodule the size of a marble was palpable. The tumor appeared to be situated beneath the serosa and was partially movable. The nodule did not present the constricting lesion typical of a small bowel carcinoma and within six inches of this nodule five other nodules much smaller in size were palpable. These were all partially movable although they were fairly hard to palpation. Because of the patient's history of intermittent bouts of fever for the past three years, it was believed that biopsy of one of the tumors rather than resection

was the safest treatment at this time. For this reason, an incision was made in the serosa over one of the nodules and it was excised without any difficulty. The incision in the bowel was then closed in three layers using two layers of No. o chromic and one of interrupted zytor. The appendix was then removed in the usual fashion. The stump was treated with phenol and alcohol and then inverted. The incision in the abdomen was then closed with No. o chromic continuous for the peritoneum, interrupted chromic No. o for the fascia, and Michel clips for the skin. No drain was inserted.

Pathologically the specimen consisted of a small, grayish white segment of tissue from the mucosa of the small bowel. On microscopic examination the characteristic histopathology of carcinoid was found.

The patient's postoperative course was uneventful. The incision healed well. He was discharged on January 25, 1945, and told to return at a later date for resection of the ileum.

On April 8, 1945, the patient was re-admitted to the Grace Hospital for a resection of the ileum. After adequate preoperative preparation, on April 12th, under continuous spinal anesthesia, a right rectus incision was made and the previous rectus scar excised. The rectus muscle was split and the abdomen entered. A number of adhesions were present between the ileum and the anterior abdominal wall where a previous biopsy had been performed. The adhesions were separated and five carcinoids, one of them the size of a marble, were found in a loop of ileum approximately twenty inches from the ileocecal valve. A bowel resection was performed by cutting across the bowel on the bias six inches away from the site of the tumors on each side. The mesentery of the bowel was then ligated, and an open end-to-end anastomosis was performed in three layers. A Witzel tube enterostomy, with the tube placed through the omentum, was performed about six inches proximal to the anastomosis. The tube was brought out through a mid-line stab wound two inches to the mid-line from the main incision. Five Gm. of sulfanilamide were left in the abdominal cavity and closure performed in the usual manner except for the use of interrupted stainless steel wire for the fascia.

Pathologically, the specimen consisted of

the ileum measuring 30 cm. in length and 2½ cm. in diameter. The serosal surface was rough and covered with adhesions. A
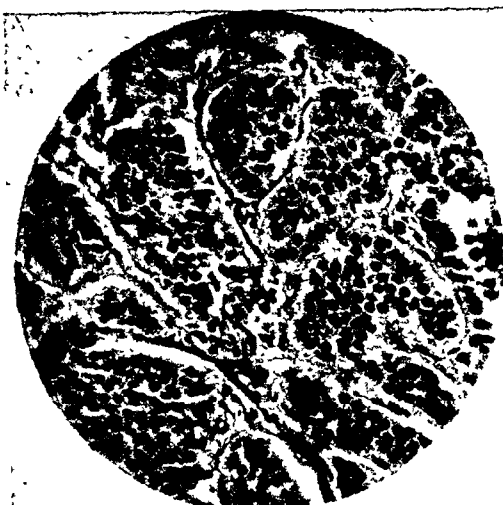
Fig. 3. High power magnification showing the characteristic histopathology of carcinoid tumor. × 400.

number of small raised nodules were found upon the serosal surface. The largest of these measured 3 mm. in diameter. They are light brown in color and soft in consistency. On opening the bowel, much bile-stained fecal material was found. The bowel wall was of normal thickness. Ten cm. from one end of the section of ileum was a stricture. At this point, the wall of the bowel measured 10 to 15 mm. in thickness. The overlying mucosa was normal. The lumen of the bowel was markedly reduced at this point.

Microscopically, the tumor tissue described above and the nodules were made up of a new growth. The cells of the new growth were quite uniform in size, shape and staining. They were small and had a clear cytoplasm. No mitotic figures were found and no hyperchromatic nuclei. The cells were arranged in small solid masses. These infiltrated the wall of the bowel, being found upon the serosal surface. The tumor presented all the histopathological features of a carcinoid of the ileum. (Fig. 1.)

The postoperative course was uneventful. The patient was discharged on his seventeenth postoperative day. He no longer suffers from attacks of abdominal pain and is apparently cured of all abdominal symptoms.

CASE II. J. R., a sixty-four year old white male, was admitted to the Grace Hospital on

August 5, 1945, complaining of severe pain in the abdomen. He noted the onset of pain in the early hours of the morning of July 31, 1945. The pains were colicky and moved all over the abdomen. Shortly thereafter, he noted that his abdomen was becoming distended. The distention became increasingly more marked during the day. He had a bowel movement that afternoon but none thereafter. He had lost all desire for food. For the past two days he had vomited repeatedly. On the day of admission the vomitus was blackish grey. Prior to the onset of the present illness he had been well and had lost no weight. The only illness that he had prior to the onset of the present illness was an operation for hernia in 1941, and an appendectomy for an acute appendix several months before the onset of the present illness.

On examination, the patient was found to be an elderly white male. He was well nourished and in obvious discomfort. His temperature was 99.8°F., pulse 88 and respirations 20. Head, eyes, ears, nose, and throat were normal upon examination. His chest was clear to percussion. Voice and breath sounds were normal; tactile fremitus was normal and there were no râles. The heart was normal in size, position, rate and rhythm, and there were no murmurs. His blood pressure was 130/80. His abdomen was distended and tympanitic to percussion. There was no shifting dullness, no peristaltic waves, and borborygmus. An indefinite mass was palpable in the lower flank with tenderness over the umbilicus.

When brought to the x-ray department on August 6th this patient's abdomen was found distended markedly and highly tympanitic. Fluoroscopic and radiographic review of the abdomen showed severe inflation of the small bowel typical of some type of small bowel obstruction. Under such conditions, examination of the esophagus, stomach and duodenum was omitted, but a barium enema was given under fluoroscopic control filling the entire colon and parts of the terminal ileum. Marked pressure effects were observed along the entire course of the colon, but especially in the lower descending colon and sigmoid. Otherwise, we could not distinguish fluoroscopically conclusive evidence of primary colonic disease. A roentgenogram of the abdomen was obtained subsequently in suitable, somewhat oblique projection. This confirmed our fluoroscopic impression. Fluoroscopic review of the chest showed moderate widening of the mediastinum as if from aortic enlargement. There was no fluoroscopically apparent cardiac enlargement or pulmonary disease. Conclusion: Intestinal obstruction involving the lower segments of the small bowel. (Dr. H. Jarre.)

Laboratory examinations showed the following: Blood type 4; urine: specific gravity 1.030; albumin: negative; sugar: negative; sediment: negative; blood: hemoglobin $16\frac{1}{2}$ Gm. (99 per cent); red blood cells 4,800,000; white blood cells 6,000; polymorphonuclears 63 per cent; filaments 60 per cent; non-filaments 3 per cent; lymphocytes 36 per cent; eosinophiles 1 per cent; the Kahn test was negative.

When the patient returned from the x-ray department, he had a large bowel movement and felt better. Intestinal decompression by means of Wangensteen suction was instituted and the patient was given glucose and saline intravenously preparatory to operation.

He was taken to the operating room on August 8th. Under spinal anesthesia, a low right rectus incision was made in the abdomen which was then opened in layers. The appendix had been removed several months previously. About 20 cm. above the ileocecal valve, the ileum was found to be matted together by the firm adherence of several loops of bowel. This matting together of the loops of ileum in this region was caused by a nodule noted in the subserosal layer of the bowel. The loop of ileum containing the nodule was resected and a three layer end-to-end anastomosis was done. A Witzel tube was placed eight inches above the anastomosis and brought out through a mid-line stab wound. The incision was closed in layers after placing 5 Gm. of sulfanilamide about the abdomen in the region of the resection. Continuous chromic No. o was used for the peritoneum, interrupted chromic No. o for the muscle and fascia, and Michel skin clips.

A specimen consisted of 30 cm. of small intestine measuring $2\frac{1}{2}$ to 3 cm. in diameter. The serosal surface was rough and discolored. In one area the surface was covered with adhesions for a distance of 3 cm. In the mucosa of the bowel opposite this area was a small hard mass measuring 3 cm. in diameter. On microscopic examination, extensive fibrosis and lymphocytic infiltration was seen in the region about the tumor. The tumor itself

presented all the characteristic histopathological changes of a carcinoid. (Figs. 2 and 3.)

The postoperative course was smooth except for the development of a wound infection which was opened and drained on the tenth postoperative day. He was discharged on the twentieth postoperative day. At present he feels very good. His appetite is excellent and his bowels move well.

SUMMARY

We have presented two cases of carcinoid of the ileum. In one of these there was partial bowel obstruction caused by the tumor (Case 11), while in the other case the tumor per se apparently produced the symptom complex found with appendiceal disease. In neither case, could the diagnosis be made preoperatively. In neither case was there any evidence of metastasis. The treatment of choice must be bowel resection in carcinoid of the ileum, not only because of the bowel obstruction as found in Case 11 but also because of the high incidence of metastasis found in this type of tumor. We believe that this type of tumor must be treated like a malignancy of the bowel, i.e., by resection, but that the patient can be given a good prognosis. Because small carcinoids of the ileum sometimes produce a symptom complex highly suggestive of recurrent appendicitis, we cannot help but wonder how many of these tumors are missed because of the small "button-hole" incisions with appendectomy in the so-called chronic appendicitis cases.

CONCLUSIONS

1. Carcinoid of the ileum although not classified with the malignancies pathologically, must be so classified for the purpose of surgical treatment.

2. Wide resection of the ileum is the treatment of choice.

3. The prognosis is excellent where metastasis has not already occurred.

4. Patients presenting the symptom complex of recurrent appendicitis should have incisions adequate for examination of the ileum for carcinoid tumors.

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Dr. Robert Sterling was the medical consultant in charge of case 11.

CHRONIC INVERSION OF THE UTERUS WITH FIBROSARCOMA OF THE CORPUS*

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BECAUSE the original neoplasm is not too common, and because of the unusual conditions present in this case, we considered it worthy of reporting.

Sarcoma of the uterus is not common, it is indeed much less frequent than carcinoma of the corpus. Among various clinics and reports, about 3.5 to 4 per cent of uterine malignancies are sarcomatous. Novak and Anderson[1] found that in a period of twenty-five years they encountered only fifty-nine cases of sarcoma of the uterus in comparison with 1,263 cases of various other uterine malignancies.

It was C. Meyer and Rudolph Virchow who in 1860 presented the first case of a uterine sarcoma before the obstetrical society of Berlin. Since then, some eighty-five years, the subject of uterine sarcoma is still in need of additional discussion and enlightenment.

The majority of clinics agree in their statistical figures that the relationship between sarcoma and carcinoma are about 1 to 30 or 40. The greatest age incidence is that during or after the menopause. Its metastases will find other organs via the blood stream, the lymphatics, or by direct extension. The liver and lungs are the commonest sites for metastases; however, other organs, such as the brain, ovary, and kidney may also be involved.

There is no specific predilection for any race or color and no definite hereditary factors.

Pathology. While sarcoma of the uterus may arise from the muscle fiber of the uterus, the connective tissue, or the endometrium, the commonest source is the fibromyomas of the uterus. Our case deals with the latter type.

The gross appearance of the neoplasm will vary; however, the usual site for sarcomatous degeneration is in the center of fibromyomas. In the usual benign fibroid of the corpus the tissue is hard, glistening, and has the circular or whorl appearance when the tumor is cut; but in the sarcomatous changes, the tissue appears necrotic or "cooked."

Microscopically, the sarcomatous changes are very much the same as those of sarcoma in other parts of the body. The spindle cell, round cell, and various mixed-cell types are the usual findings. However, Novak, Evans,[2] and Kimbrough[3] believe that the degree of mitotic activity may reflect the severity of the malignancy and its clinical prognosis.

The incidence of sarcomatous degeneration of fibromyomas is probably .5 to 1 per cent. Novak's findings are about as above while Kelly and Cullen in 1909, found about 1.2 per cent; other clinicians and pathologists range from .5 to 4 per cent.

Kimbrough[3] states that sarcoma originating from fibromyomas bear a much brighter prognosis than the primary sarcoma; and in his experience the favorable ratio was 3 to 1.

The primary sarcomas originated in about 75 per cent of women who were in the postmenopausal age, and only 10 per cent in younger women. Because of this, the incidence of cures are less during the menopausal age as compared with the younger women.

An interesting and ingenious prognostic method of Evans[2] and corroborated by Kimbrough[3] in relation to the number of mitotic figures per cubic mm. of tissue as to the severity of the malignancy, can be

applied to the sarcomas, both primary and secondary types. It may be stated that the more mitotic figures, the more malignant is

not characteristic and the diagnosis is usually made during or after surgery or histologically. However, abnormal uterine

FIG. 1. Original photograph of inversion showing tumor mass with patient in lithotomy position.

FIG. 2. Original photograph showing inversion and tumor mass.

FIG. 3. Microscopic sections of fibrosarcoma.

the neoplasm; the fewer or absence of mitotic figures leads to a less malignant growth and consequently a better outlook.

Symptomatology of uterine sarcoma is

bleeding during or after the menopause, especially when associated with fibroids, should make one suspicious of a probable sarcoma of the uterus. Also, an abnormal

leukorrhea in a patient with fibroids which may or may not be bloody should give rise to a possibility of sarcoma uteri; and if the discharge becomes foul due to decomposition of tissue or necrosis, it may also point to sarcoma. We observed a case in which abnormally fast growing myomas proved to be sarcomatous.

Our case of uterine fibrosarcoma was complicated by complete chronic uterine inversion.

Non-puerperal uterine inversions are usually caused by some sort of neoplasms of the fundus. These tumors by means of traction and in the presence of a relaxed uterine wall will create an inversion. It is reasonable to assume that without the relaxed uterine wall a spontaneous inversion is almost impossible. Fibromyomas are the commonest tumors associated in a non-puerperal inversion.

CASE REPORT

Mrs. J. S., No. 28928, age seventy-six, was admitted to the Gynecological ward of the Cook County Hospital on July 20, 1944. She spoke no English and data were obtained from her husband who spoke English poorly. She apparently was in fairly good health until one year ago when she noticed vaginal bleeding and "something bulging" through the vagina and between her thighs.

She passed her menopause at the age of fifty. Her blood pressure was 116/60; hemoglobin 80 per cent; red blood cells, 3,850,000; white blood cells, 8,850; urine examination showed albumin 0, sugar 0, casts 0.

The external genitalia were atrophic. Bartholins, Skenes, and urethra were negative.

There was a large necrotic mass protruding from the vagina measuring the size of a large orange which was elongated. To the right of the midline of this mass there was another adherent decomposed necrotic tumor measuring about 4 by 4 cm., the center of which appeared "cooked" while the periphery was yellowish-green. It was friable and bled easily on slight touch. The whole protruding mass was markedly edematous and it was impossible to reduce it back into the vagina.

A preoperative diagnosis of chronic uterine inversion was made, accompanied by a degenerating fibromyomas. However, malignancy was considered as a probability.

A vaginal hysterectomy was done on August 31, 1944, and histologic sections proved it to be a fibrosarcoma.

CONCLUSIONS

Uterine fibromyomas may undergo malignant transformation.

Statistical data were presented.

Intrauterine neoplasms predispose to a possible spontaneous uterine inversion.

A case is presented in which the chronic inversion was associated with fibrosarcoma.

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Editorial

APPENDICITIS IN COMBAT ZONE AS SEEN IN A FIELD HOSPITAL

THE August, 1944, edition of the American Journal of Surgery contains an editorial by Captain J. E. Porter and Lieut. Commander G. H. Pratt of the United States Navy on "Operations in the Tropics." This reviews the "experiences in a United States Naval base hospital" and draws certain conclusions. One of these is that "right sided abdominal pain should be considered appendicitis until proven otherwise." The implication is that in the light of present therapy, all these patients should be operated upon.

This point was the subject of much discussion in the pre-invasion period in the United Kingdom at our staff conferences. The question was whether prophylactic appendectomy should be done at once in such cases, or whether, in the absence of definite signs of organic disorder, this could be delayed. Proponents of immediate operation believed that the trouble would recur, and that operation, even though immediately removing a man from his unit and training program, was inevitable. It was also suggested that the chances for survival would be better since the attack might occur when and where medical care was not available. Proponents of delay thought that recurrence (1) was not assured, and (2) if it happened operation

added little or no risk in view of the prospective medical set up. Meanwhile, a valuable man was left in the unit and allowed to complete training toward the objective for which he had been inducted. In other words the danger to the individual was believed to be so slight as to be outweighed by the greater good of the whole army.

The question of the presence of "invasion appendicitis" occurred not infrequently in the differential diagnosis. It was noted that during the five months the same units were serviced, rehospitalization of patients not operated upon occurred within several weeks of the original admission, if at all.

It was proposed to study cases (twenty-two) in the patients operated upon in the combat zone in July and August, 1944, in the light of (1) history of previous hospitalization for the same symptoms and (2) morbidity and mortality compared to a series (forty-seven) done in the pre-invasion period (November 1943 to April 1944). The cases studied were done by the same hospitalization unit of a field hospital and the surgical team attached at the time. The entire hospital was acting as a combined station hospital and holding unit at the time. It was supplying medical and

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surgical service to the surrounding service units while receiving patients for evacuation from divisional field and evacuation medical units, and also some battle casualties directly from the front lines.

Twenty-two patients diagnosed as cases of appendicitis were operated upon in the field. Twenty were found to have definite disease grossly, one was negative and one was found to be suffering from a right ureteral calculus. Due to pressure of work and also to the use of Forms MD 52c and 52d, a record of previous hospitalization for similar complaints was not noted. In fifteen of these cases seen by the writer, there was no history of previous hospitalization.

A comparison of symptomatology was interesting in that, as expected, the symptoms were more definite and the findings clearer. The only questionable cases were the two noted above. One was a combat exhaustion case with symptoms of twelve hours' duration which became worse while in the holding unit. After twelve hours' observation, he was explored and a normal appendix found. There was moderate increase in the white and differential count. At the time all patients were being evacuated to the United Kingdom and the time of evacuation was uncertain. The other patient was admitted at night from an advanced unit with the diagnosis of acute appendicitis and was operated upon at once. The symptoms and history were considered typical. Persistence of symptoms and subsequent urinalysis revealed the true diagnosis.

The remaining eighteen cases showed advanced pathological conditions as compared to those in the United Kingdom series. So-called mild cases of catarrhal appendicitis were not seen. In this series the appendix was markedly injected and swollen with free fluid in almost all patients. One case of diffuse peritonitis was encountered. This was in a service soldier who was admitted with a temperature of 105°F. and a nasopharyngitis. The abdominal symptoms were generalized with a white count of 25,000 with 91 per cent polymorphonuclears. The Ochsner treatment plus sulfadiazine and penicillin were used, and the appendix removed on the fourth day through a McBurney incision. The appendix was of the pelvic type and was walled off by the surrounding bowel. The wound was packed to the peritoneum with vaseline and left open after the method advocated by Kennedy of Philadelphia. Convalescence was uneventful, and he was evacuated on the fifth day. The wound was still open but the packing had been removed and the incision was clean. The patient was on soft diet and had had a normal bowel movement. No cultures or microscopic studies of the appendices were made due to lack of facilities.

There were no fatalities in either series. A comparison of morbidity was not possible due to the fact that the field cases were evacuated on the seventh day with the exception of the peritonitis case. This was sent out earlier due to the fact that the hospital was moved.

Complications were confined to one patient who had a series beginning with pneumonia, followed in sequence by dehiscence, intestinal obstruction of small bowel through a tear in the omentum and, finally, thrombophlebitis of the left leg. He finally cleared up and was evacuated on the fourteenth day. A right rectus incision was used. The appendix was of the suppurative type. Spinal anesthesia was used.

Postoperative pneumonia occurred in one patient in the United Kingdom series, also done under spinal anesthesia.

There were no wound infections grossly in the Normandy cases. One wound infection occurred in the United Kingdom series, following soiling in the removal of a large mucocele type of appendix. This was the size of a thumb and acutely inflamed. From the above it is evident that there were no more postoperative difficulties in the field than under garrison conditions.

Sterilization of linen supplies was done by the field type (gasoline) sterilizers in

both series. Spinal anesthesia was used in all the field cases and most of the garrison cases. Some failures were noted, contributed to, in part it was thought, by the use of other than American preparations. Ether and sodium pentothal were used for supplementary anesthesia when necessary.

In conclusion, experience in a small number of cases diagnosed acute appendicitis operated upon in combat zone, as compared to a larger number operated under garrison conditions, indicates that cases seen are farther advanced pathologically in the combat zone. The results as far as morbidity and mortality showed no demonstrable difference. No conclusions as to the necessity for prophylactic appendectomy could be drawn, aside from the negative one that the factor of safety was not decreased in the combat zone. The necessity for routine urinalysis in all abdominal cases was emphasized by the one case of ureteral calculus in which the patient was operated upon.

MAJOR HYMAN SNEIERSON, M.C.

CONSTIPATION is so usual in the early stages of appendicitis that when diarrhoea accompanied it the true diagnosis is liable to be overlooked. If diarrhoea is accompanied by even slight, but constant, tenderness and some rigidity in the right iliac fossa, other things being equal, the appendix should be explored.

From "A Short Practice of Surgery" by Hamilton Bailey and R. J. McNeill Love (H. K. Lewis & Co. Ltd.).

Original Articles

A METHOD OF CONTINUOUS BRACHIAL PLEXUS BLOCK*

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THE duration and effect of anesthetic agents injected locally or regionally is, of course, limited by the inherent ability of the agents used to withstand absorption from the site of injection. Local anesthetic agents, such as, p-amino, benzoic acid esters, have a limited usefulness on account of their relatively short effect. The usual dose of the soluble type (procain) will give anesthesia for a relatively short time. The relative toxicity of long-acting agents (nupercain, pontocain) prohibit their use for brachial plexus block on account of the large quantity necessary for this procedure. Fifty cc. of 1 per cent procain will lose its anesthetic effect within forty to sixty minutes. If the operation lasts longer than the anesthetic effect of the agent, it then becomes necessary to supplement the local or regional block by a general anesthetic procedure which usually is not desired and oftentimes deliterious. This constant concern about the limitations of the anesthesia frequently causes undue haste in operative procedures. Occasionally, it is absolutely necessary to do the procedure under nerve block alone because the patient's physical economy will not withstand any other form of anesthesia. It is assumed that nerve block is the ideal procedure in the bad risk case since the least physical factors affecting the patient are brought into play. Nerve block procedures are often the method of choice over all other anesthetic procedures and are employed particularly when the stress of any procedure is considered too great for the patient's physical ability to withstand it.

Long-drawn out procedures on extremities which are done under general anesthesia frequently exact a physical price from the patient, in the way of post-anesthetic complications (atelectasis, shock, dehydration) that are all out of proportion to any possible good resulting from the operation. Thus it is evident that if a regional nerve block (brachial plexus block) could be certain to be effective and to last as long as the surgical procedure required, it would be desirous. For this reason, continuous block of the brachial plexus is employed. Heretofore, the procedure of brachial plexus block was noteworthy for its many failures. This was usually due to faulty technic in which the anesthesiologist had not properly placed his needles and the anesthetic solution had not come into contact with the nerves of the plexus. Many and various procedures were elaborated in an effort to effect a method that would be successful in all cases.

In 1911, Hirschel[1] blocked the brachial plexus through the axilla and the next year Kulenkampff[2] introduced his supraclavicular method which has been used most frequently and is safer than the infraclavicular and axillary routes. How-

ever, there were frequent failures by any of these methods. Macintosh and Mushin,[3] on the basis of previous work

anatomy must be visualized. The brachial plexus consists of the anterior primary divisions of the last four cervical nerves
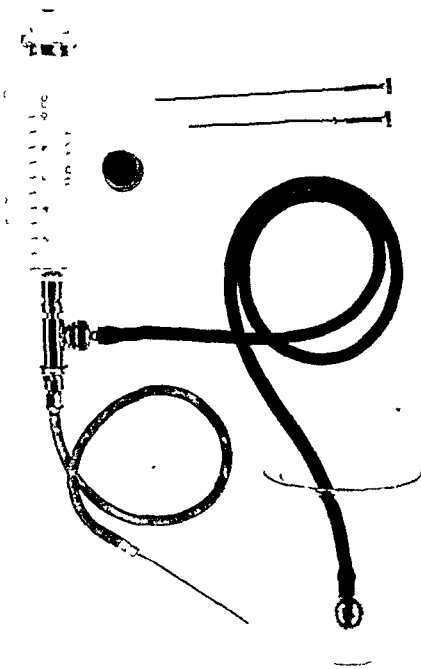
FIG. 1. Apparatus consists of a 10 cc. Luer lock syringe and the two-way valve as used in the Hingson-Edwards continuous caudal method. The tubing can be of any desired length (18 inches is sufficient). A malleable needle (Becton-Dickinson & Company) that has been filed to a blunt end to prevent perforation of blood vessels is used. A cork stopper from an ether can completes the apparatus.
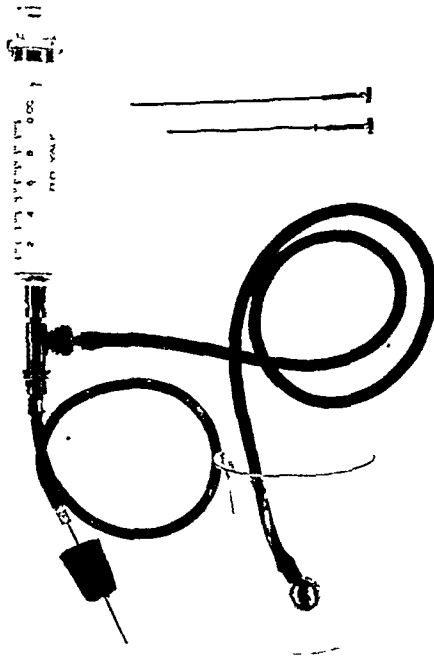
FIG. 2. Apparatus with needle through the cork, usually 4 to 6 cm.

by Patrick,[4] have proposed a method which is well adapted to prevent failures. In the writer's experience it has proved valuable and trustworthy and particularly so after a long experience with other methods in which many failures occurred. This method suggested to the writer the possibility of continuing the injections with the needle remaining in situ and for this purpose a suitable apparatus was devised. (Figs. 1, 2, 3 and 9.)

ANATOMY OF THE BRACHIAL PLEXUS

To understand and perform brachial plexus block properly, essential points in

FIG. 3. Close view of blunted needle through the cork guard. The cork, when placed flush with the skin in the supraclavicular area, prevents the needle from going in deeper.

(C-5, 6, 7 and 8) and the first thoracic nerve. From these five roots, three trunks
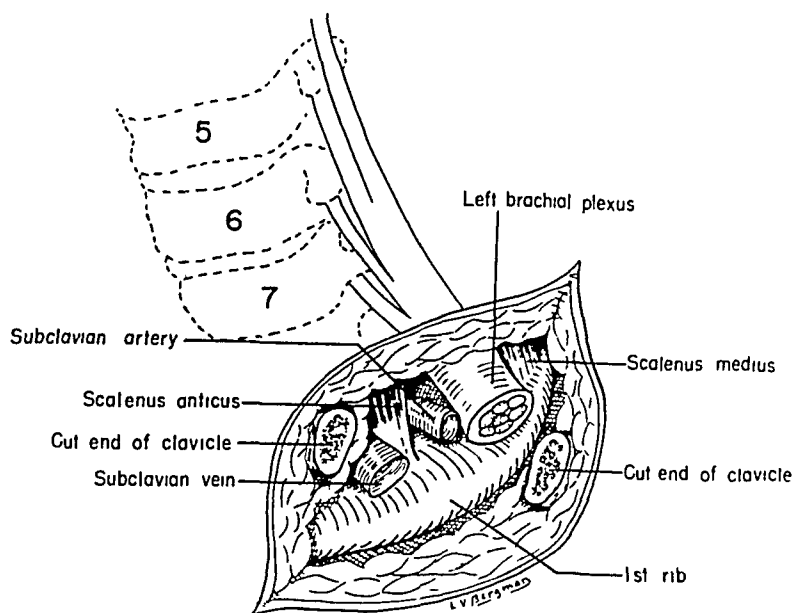
FIG. 4. Anatomical position of the brachial plexus which lies latent to the subclavian artery and between the insertions of the scalenus medius and anticus muscles. The subclavian vein is separated from the artery by the scalenus anticus muscle and lies under the surface of the clavicle and is not liable to puncture by needle.

A   B
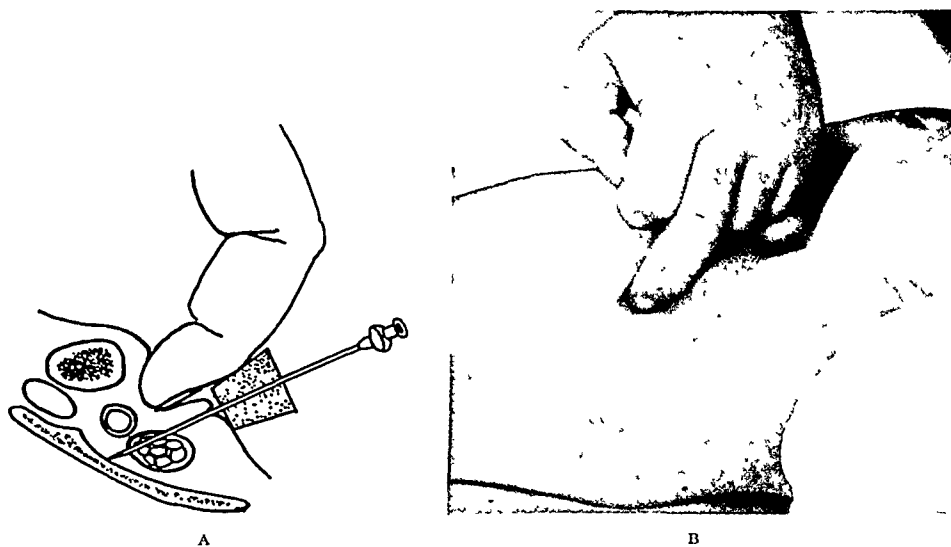
FIG. 5. A, palpating the pulsations of the subclavian artery as it crosses the first rib, the needle through the cork is guided by the palpating finger to a position lateral to the artery and in contact with it. When the needle strikes the first rib the cork is brought down flush with the skin. This maneuver holds the needle upright and prevents it from penetrating deeper. B, palpation of subclavian artery. First step in guiding needle to position lateral to it in apposition to plexus.

(upper, middle and lower) are formed which, in turn, give off six branches, an anterior and posterior branch from each trunk. All the posterior branches unite to form the lateral or outer cord from which is given off the musculocutaneous nerve and the lateral root of the median nerve. From the anterior division of the lower trunk arises the medial or inner cord which gives off the median root of the median nerve which joins with the lateral root to form the median nerve proper. The ulnar nerve is also given off from the medial cord. Thus the plexus may be said to begin with five nerves and to end with five nerves with its intermediate portions in sets of three (three trunks, three sets of anterior and posterior branches, and three cords).[5]

The nerves converge downward and outward and are closely grouped together as they cross the first rib between the fascial sheaths of the scalenus anticus muscle and scalenus medius muscle which are inserted on the first rib. (Fig. 4.) The relationship of the plexus to the sub-clavian artery in passing over the first rib is an important landmark in brachial plexus block. The plexus lies close, and lateral, to the artery. The subclavian vein lies under the clavicle and is not palpable. By feeling the pulsations of the sub-clavian artery as it crosses the first rib (Fig. 5A) and inserting a needle close by it, contacting the first rib, the plexus may be reached with certainty. In order to insure proximity to the artery, the needle should move with the pulsations of the artery. (Fig. 8.) If the point of the needle is lying on top of the first rib and is pulsat-ing with the subclavian artery, then it, of necessity, lies in contact with the brachial plexus as it crosses the rib. By retaining the needle in its position next to the subclavian artery and holding it there by suitable means fractional injec-tions of procain may be made.

PROCEDURE

By using a blunt needle (Fig. 3), of the malleable type, and inserting it to the lateral side of the subclavian artery in contact with the upper surface of the first rib and observing it pulsating with the artery, one may be assured that he is in the proximity of the plexus. Paraesthesias
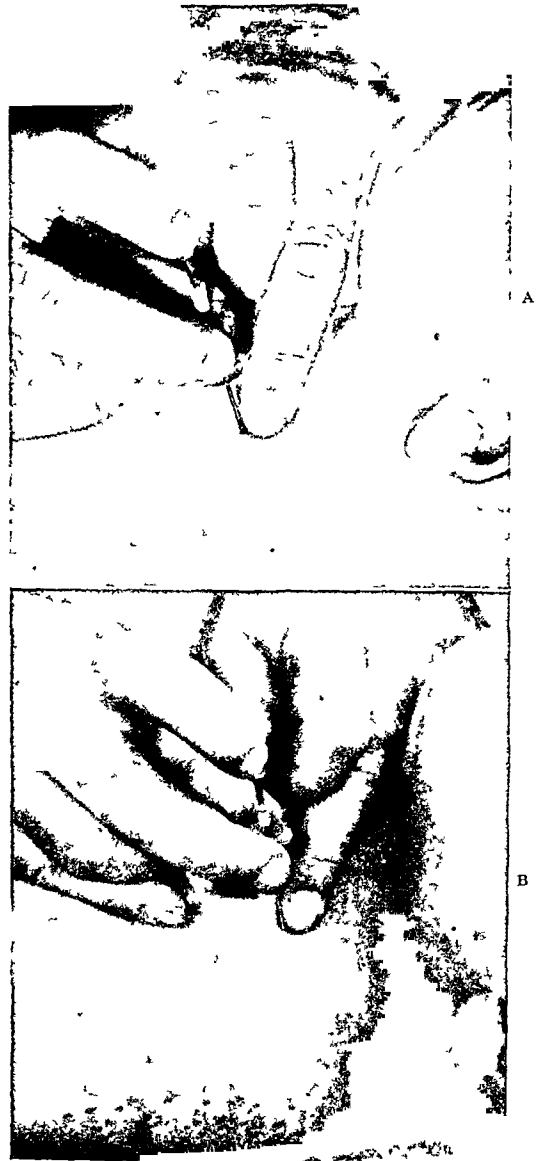
Fig. 6 A, with finger of opposite hand above the clavicle palpating subclavian artery as it crosses the first rib, the needle through the cork is inserted through a wheal 1 cm. above the clavicle and usually at its mid-point and directed backward, inward and downward to contact the rib. The palpating finger readily guides the needle to its proper place and pre-vents it from perforating the artery. B, insertion of the needle downward, inward and backward. The needle has been rotated away from its correct position for the sake of clarity.

in the form of shooting pains down the arm caused by the needle contacting the plexus are helpful and give further assur-

syringe. (Figs. 1 and 2.) The needle is retained in place by the use of a cork through which the needle is inserted

FIG. 7.
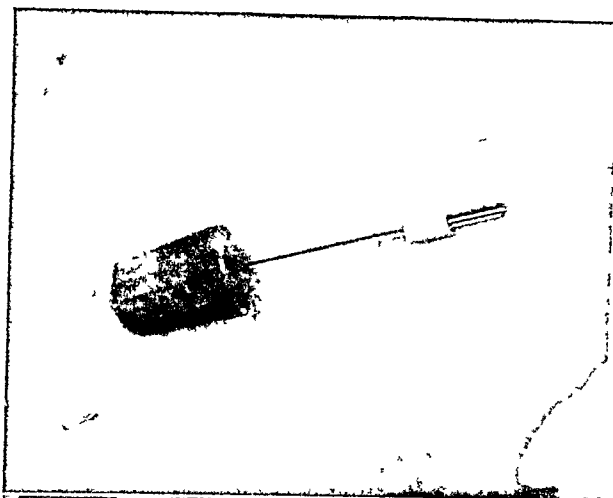
FIG. 8.

FIG. 7. Needle in place in the supraclavicular area. The cork prevents displacement inward and holds it upright.
FIG. 8. Pulsation of the needle indicating its close apposition to the subclavian artery. If the needle is placed lateral to the artery and on top of the first rib, it of necessity is in close proximity to the plexus. Injection of 30 to 40 cc. of 1 per cent procain will induce anesthesia within fifteen minutes.

ance of proximity, but they are not essential to success with this technic. If procain is injected at this location in sufficient quantity, a successful infiltration of the plexus will result. The needle is blunted to prevent perforation of the artery while remaining *in situ*. By retaining the needle in this position, fractional injections of procain may be made through rubber tubing of convenient length attached to a

before passing it through the skin in the supraclavicular area. (Figs. 3 and 7.)

The cork serves the purpose of holding the needle firmly upright and in preventing its movement inward. This is accomplished by placing the cork in contact with the skin after the needle has been properly placed. (Fig. 7.) Adhesive strapping over the cork prevents outward displacement of the needle as it is held

securely in the cork. (Fig. 9.) One per cent procain without adrenalin is used and following careful aspiration to assure

lasted for the entire procedure (two and one-half hours). Infiltrating the skin area above the clavicle and acromion and
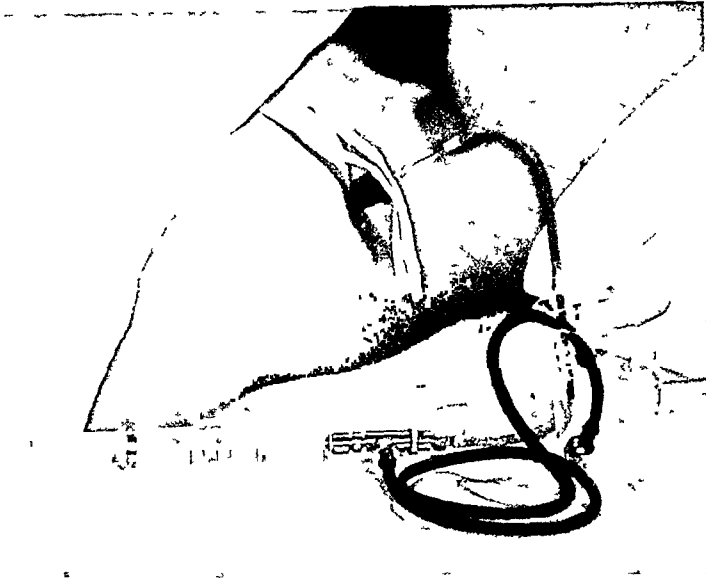
FIG. 9. Apparatus in place and ready for fractional injections. The adhesive strapping over the cork keeps the needle in place and prevents its outward displacement. The cork firmly holding the needle prevents its inward displacement.

that the needle is not in a blood vessel, 40 cc. is injected as the initial dose. The onset of anesthesia may be prompt or slow depending upon the proximity of the needle to the plexus. The usual length of time is fifteen minutes following completion of the injection. It has been noted by others[3] that 1 per cent procain does not produce motor paralysis whereas 2 per cent does affect motor nerves. This finding was confirmed in this series of twenty-seven cases. The average duration of anesthesia was two hours, the longest case being four hours twenty minutes, and the shortest one and one-half hours. Good sensory anesthesia was obtained in all cases. The procedures varied from open reduction operations on bones of the forearm, arm and shoulder to repair of the median nerve and palmaris longus tendon. For shoulder operations an additional injection must be made at the fourth cervical transverse process to block C4 nerve which supplies the skin of the shoulder. In one case this single injection

circularly about the axilla along its thoracic surface may also be done to block the superficial branches of the cervical plexus.[6]

There were slight toxic effects noted in three cases (sweating, pallor) but no change in blood pressure, pulse or respiration. The majority of the patients on returning to bed expressed a desire for food and did not require opiates for several hours after operation. Those with casts on the arm and chest were sitting up and moving about freely immediately postoperatively. The amount of solution varied from 120 cc. used in one and one-half hours to 220 cc. in four-hour cases. These dosages were within the safe range for detoxification by the body. In an early case in this series, a hematoma in the supraclavicular area developed from perforation of the artery by a sharp needle but had no ill effects. It was noted that the onset of anesthesia was greatly prolonged in this case probably due to the extravasated blood preventing procain from contacting

the plexus. Perforation of the subclavian artery is of no importance and is not likely to occur if one uses a blunt needle. A sharp needle of large gauge is used to perforate the skin and is then withdrawn. The blunt needle follows the track through the skin made by the sharp needle or the new type Hingson-Edwards needle—blunt end with sharp obturator—may be used and is more suitable. Subclavian artery perforations have been purposely done repeatedly by investigators to obtain samples of arterial blood without any harmful effects.

Horner's syndrome (ptosis, miosis and anhidrosis) was not evident in any of the patients which indicates that the solution of novacain did not extend upward through the rami communicantes to affect the stellate ganglion. However, the application of this method in peripheral vascular conditions of the upper arm is evident. This is based on the anatomy of the sympathetic components of the brachial plexus which are arranged as follows:

The anterior primary divisions of C-5 and 6 receive a gray ramus communicans from the middle cervical sympathetic ganglion. C-7 and 8 somatic nerves receive a gray ramus from the inferior cervical sympathetic ganglion. The first thoracic nerve is connected by two rami communicantes with the first thoracic sympathetic ganglion. The sympathetic fibers accompany the brachial plexus and are distributed to the blood vessels. Thus block of the brachial plexus produces both a somatic anesthesia and a sympathetic anesthesia. This blocking of the sympathetic ganglion at the brachial plexus produces a vasodilatation of the arm, hand and wrist and accompanying rise in temperature in these locations without the development of a Horner's syndrome. The latter syndrome, however, may be effected by a diffusion of the procain upward along the nerve roots to the stellate ganglion. Although this has been noted by others,[3] it did not develop in any of the cases reported here. This release of vascular tone is made evident by a rise in skin temperature of the affected extremity to the extent of 4°C.

The effective use of continuous brachial plexus block involving the sympathetic supply of the arm was evidenced by its use in brachial artery embolism of cardiac origin. In this case, a painful, swollen, cold, wet and cyanotic arm and hand was replaced by a painless, warm, dry and pink extremity within two hours after continuous block of the brachial plexus was established. Unfortunately, a pulmonary embolus wrote finis to the case within another hour. On the basis of this case the utilization of continuous brachial block in upper extremity vascular accidents as a means of inhibiting vasospasm and thus promoting collateral circulation is recommended. The relief of pain in the arm during this episode was complete and came on within fifteen minutes.

SUMMARY

Twenty-seven patients requiring operation of the shoulder, arm, wrist and hand had brachial plexus block by the continuous method. Anesthesia was successful in all cases and it was not necessary to supplement any with general anesthesia. The duration of operations extended from one and one-half hours to four hours twenty minutes. The possible utility of the method in peripheral vascular conditions of the upper extremity is suggested.

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That Mothers Might Live

By DEAN CORNWELL, N. A.

Oliver Wendell Holmes, 1809-1894, reading his celebrated essay entitled "The Contagiousness of Puerperal Fever" before the Boston Society for Medical Improvement in 1843.

OLIVER WENDELL HOLMES was a young man thirty-four years of age when he wrote this famous essay on childbed fever. He had obtained his M.D. degree at Harvard Medical School just seven years before and in the interval had been for two years professor of anatomy and physiology at Dartmouth College. How he came to write it he tells in the preface to a monograph entitled "Puerperal Fever as a Private Pestilence" and published in 1855. These are his words:

"A discussion arose in a medical society of which I was a member, involving the supposed cause of a disease, about which something was known, a good deal suspected, and not a little feared. I felt that it would be doing a good service to learn what experience had to teach in the matter."

His celebrated essay was the result of this searching inquiry. It is at once a model of cold scientific reasoning and of impassioned pleading. Even today it is impossible to find in it a statement which is false or an argument which can be refuted. We can still profit by his plea never to neglect anything, whether through ignorance or prejudice, that can make childbearing safer for women throughout the world.

Pioneers of American Medicine

The reproduction "That Mothers Might Live," on the opposite page, is the sixth in a series of original oil paintings by a famous American artist depicting historical scenes in the lives of great American physicians and surgeons.

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It is hoped by Wyeth Incorporated that the series "Pioneers of American Medicine" will contribute in some small measure to the history of medicine and afford a clearer recognition of the achievements of American medical heroes.

INDICATIONS AND ADVANTAGES OF COMPLETE ABDOMINAL HYSTERECTOMY VERSUS INCOMPLETE HYSTERECTOMY*

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BECAUSE of distressing symptoms of leucorrhea, occasional bleeding from the cervical stump or polypoid protrusion, we became dissatisfied with the operation of subtotal hysterectomy. Being inspired by the technic and results of total hysterectomy obtained by Masson, Counsellor and Sanders, we began, five years ago, to replace the subtotal with the total procedure in most cases requiring hysterectomy.

It is not, however, our purpose to precipitate a controversy between those who favor subtotal to total hysterectomy or the incomplete removal of the uterus to the complete. It is a matter of opinion whether adequate cauterization of the cervical canal and the proper repair of lacerations is sufficient as a prophylaxis against future cervical stump cancer or the disturbing local or systemic effects of latent or recurring cervical infection. This problem must be evaluated by the operating surgeon and a decision made upon his experience and clinical observation.

It is our desire to relate our experience with total abdominal hysterectomy and to explain our preference for this procedure in the vast majority of cases.

My brother, Dr. Paul Hunt, and I have performed, since 1940, the complete removal of the uterus in 243 cases, without a mortality, without an injury to the bladder or ureters and with no added hospitalization period.

Bleeding during the operation has not been a problem. Postoperative recovery has not indicated pelvic infection. This we believe to be less in the total than in the subtotal operation. As mentioned by Masson, cutting across the cervix opens a field for infection even though the canal has been thoroughly cauterized. Cauterized tissue becomes necrotic and a fertile field for infection, which is conducive to thrombophlebitis. There was one case of postoperative thrombophlebitis in this series, which subsided by paravertebral block and dicumerol in a short period, with only slight residual leg edema.

There has been only one case that presented any postoperative bleeding and this was easily controlled. Such occurrence is negligence and due to failure to close adequately the vaginal vault—in this instance, at the side of the vaginal vault suture. At this angle vaginal mucosa may retract and not be included in the suture and subsequently bleed.

The average postoperative stay in the hospital was 14.7 days. The time of operation was not prolonged appreciably over that of subtotal hysterectomy. The average time taken for operation was less than one hour. Sixty-five per cent of the patients were operated upon under spinal anesthesia, an agent which gives excellent relaxation and permits of better exposure. The average age of the patients was forty-three years; 213 were for fibromyoma, six for fundal carcinoma, four for carcinoma of the cervix, twenty for miscellaneous pelvic disorders, ovarian cysts, tubo-ovarian disease and endometriosis.

We have not encountered any of the objections often emphasized against the

total removal of the uterus. The vaginal vault has been well supported in all cases and there has been no shortening of the vagina except in those cases having a congenitally short vagina and where a cancer of the cervix had been treated previous to operation by radium and x-ray therapy, in which instance a wide vaginal cuff was removed along with the cervix. Frequent inquiries as to marital relations following this procedure have resulted in satisfactory replies in most instances. There has been no distressing leucorrhea, no periodic bleeding and naturally no carcinoma following the procedure.

We, therefore, from this experience, believe total hysterectomy is preferable in the vast majority of cases to subtotal hysterectomy for lesions requiring the removal of the uterus. We do not by any means advocate the complete removal as a routine. Each case has to be individualized and the appropriate procedure decided upon. The age of the patient, the condition of the cervix, the anatomical obstacles at the time of exploration and, as Masson has said, to some extent the wishes of the patient are to be considered.

If the patient is fat, the pelvis deep and inaccessible, the lower uterine segment fixed by fibrosis, or endometriosis with a firmly adherent rectum and rectosigmoid, total hysterectomy is contraindicated. A normal cervix in the nullipara does not necessitate the removal of the cervix. It is likewise preferable not to do so in a young individual without cervical disease or familial cancer tendencies.

However, when the individual is in the mid-period of life, near or after the menopause, has borne children, has an infected cervix, enlarged, eroded or scarred by lacerations, with or without appreciable leucorrhea, we believe the cervix should be removed along with the fundus. The entire uterus should be removed in all cases when fundal carcinoma is known to be present or suspected and, in some instances in which cervical cancer has been controlled by radium and x-ray. It does not seem to be desirable to remove the uterine disorder and retain the most vulnerable portion from the standpoint of cancer or distressing sequelae.

CANCER OF THE CERVICAL STUMP

It is to be admitted that the incidence of cancer of the cervical stump is not great and may not be considered as an indication for total hysterectomy. Certainly not, if the mortality of the operation exceeds the incidence of cervical stump cancer. Gellborn and Spain stated that the danger from total hysterectomy is far less than that of cancer of the cervical stump. Sanders states that cancer of the cervical stump is sufficient in number to make total hysterectomy a definite indication. He had four cases last year. A mortality of less than 1 per cent in 1000 complete hysterectomies justifies this statement. Foss reports the incidence of cancer in the remaining cervical stump, from a review of sixteen authors, to be 2.60 per cent and the mortality of total hysterectomy as against subtotal hysterectomy as reported by twenty-two authors, to be 3.87 and 2.35 per cent, respectively. However, Masson reports an incidence of 4.4 per cent cervical stump cancer in a period from July 1, 1930, to December 31, 1938, as against a mortality rate of 1.2 per cent in total abdominal hysterectomy. Masson states by communication that they have seen over 200 cases of carcinoma of the cervical stump, some of them many years after the incomplete operation. Counsellor reports 666 total hysterectomies at the Mayo Clinic in 1944 with one death. Foss recently reported 200 consecutive total removals without a mortality.

During the first five years of the Ellis Fischel State Cancer Hospital, of Missouri, there were seen 416 cancers of the cervix, eleven of which were of the cervical stump, all developing three years or more after subtotal hysterectomy. There were twenty-two in which the lesion was seen in the first six months following subtotal

hysterectomy. Lockwood, in the last three years, has treated 100 cases of cancer of the cervix, sixteen of which were in the cervical stump. The longest postoperative period was thirty-two years, four less than one year and one less than six months. In addition, there were ten cases of cancer of the cervix diagnosed from the surgical specimen and by biopsy of the stump while the patients were convalescing in the hospital from supravaginal hysterectomy.

This indicates that many cases have an unknown incipient cancer of the cervix at the time of subtotal hysterectomy, which emphasizes the importance of careful investigation of the cervix before operation, often by biopsy or curettage. Meigs states that the problem of cancer of the cervical stump is a real one and that there is no excuse for not removing the cervix, except in bad risk patients and where anatomical difficulties exist. Von Graff condemns coning out the cervix as it leaves the squamous epithelium of the cervix.

Richardson, discussing the contributions of Telinde and Galvin, calls attention to the frequency of unsuspected carcinoma of the cervix found over a period of two years in the routine biopsy of every patient coming to the operating room and some in the out-patient department. During this period of time they found sixteen cases with early histologic changes in the epithelium characteristic of cancer, and after total hysterectomy and careful histologic study this diagnosis was confirmed in fifteen of these cases. Furthermore, in a series of 300 cases in which total hysterectomy had been performed for a benign lesion and cervical cancer was not suspected, it was found in four cases. Novak states that many of the earliest cancers have been in cervices which showed little or no gross clinical change.

It must be remembered that cervical cauterization protects only against adenocarcinoma of the cervix and not against the squamous cell carcinoma, which is by far the most frequent. An analysis by Allebach of the cervical cancers at the Research Hospital for a twenty-one-year period shows twenty-seven, or 10.1 per cent adenocarcinoma; and 240, or 89.9 per cent, squamous cell carcinoma, in a total of 267 cases. Also, cancer of the cervix is more lethal than cancer of the fundus. They are usually Grade III or IV, while the fundal carcinomas are Grade I and II.

BENIGN LESIONS OF THE CERVICAL STUMP

There are other reasons, however, more rational for the removal of the cervix along with the uterus than cancer. Novak says the cervix serves no function after removal of the uterus and just as good a pelvic floor can be made if it is removed. Its retention results often in troublesome leukorrhea, even if cervical cauterization or conization are done. Frequently the cervical stump has to be amputated because of this distressing condition and often periodic bleeding is so persistent that radium or amputation must be employed. We often have had this experience. Variable degrees of leucorrhea are common, after subtotal hysterectomy, but is never present after total removal. We have found an infected cervical stump and annoying leucorrhea in thirty-five of sixty patients upon whom we had performed cervical cauterization and subtotal hysterectomy. Many never had it before. Cauterization may be conducive to infection. Masson states that in more than 500 instances treatment was necessary because of cervicitis with leukorrhea. In many of these cases there was no history of this condition before the body of the uterus was removed. He believes this is due to interference with the blood supply of the cervical stump with infection in the cervical glands. Because of these reasons, in the last 2,000 hysterectomies he thinks he has not done more than fifty subtotal operations. Also, cervicitis may act as a focus of systemic infection or may be the seat of a polyp or even fibroid tumor.

ESSENTIALS OF OPERATIVE TECHNIC

The operation of total abdominal hysterectomy should never be attempted except by one familiar with the technic. It is not an operation for the occasional operator or for one not thoroughly familiar with the essentials of the procedure. It is our policy in all cases in which there is no ovarian disorder to conserve the ovaries when possible. Large lesions may so approximate the ovaries that adequate blood supply cannot be maintained. Usually one ovary can be conserved. The tubes, as emphasized by Masson, have no further purpose and may necessitate later surgery. We, therefore, usually remove the tubes. If left, their blood supply may be impaired as they must depend upon collateral circulation from the ovarian arteries, the principal supply having been abolished when the uterine arteries were ligated. Masson wisely emphasizes that the possibility of thrombophlebitis is less likely when the tubes are removed, as it eliminates slowed or stagnant circulation in the mesosalpinx.

The bladder is protected from injury by carefully stripping it down under direct vision, either by gauze dissection when not adherent or by sharp dissection. After ligation of the round ligament and division and ligation of the tubal pedicle, the ureters can be palpatated by passing the hand behind the broad ligament and the thumb in front. The ureter can be felt to roll between the thumb and index finger. Its location can be determined. The ureters are protected by placing clamps on the uterine arteries high, as stated by Masson, at the internal os, both for total and subtotal hysterectomy alike. Keep close to the uterus, do not clamp below the internal os and the ureters will be safe. If the tumor is large and access is not possible, it can be removed in piecemeal and the ureters located and the bladder protected. If bleeding in the broad ligament occurs, the ureters should be isolated.

With the bladder well dissected down below the cervix, with the uterine arteries clamped at about right angles to the internal os, divided and securely ligated by fixation suture ligature, the cardinal ligaments can be freely divided and by traction upon the uterus the cervix can be pulled up and actually enucleated from the vaginal vault, stretching to its maximum the vaginal mucosa around the cervix. The uterosacral ligaments and posterior peritoneum having been previously divided, the vaginal vault is opened with safety from behind and the cervix is removed by curved scissors at its attachment to the vaginal mucosa, conserving the entire length of the vagina. Right angle clamps placed below the cervix necessitate broad ligament dissection well below the distal end of the cervix at the side of the vault of the vagina. This is far below the point of safety of the internal os and greatly increases the danger of ureteral or bladder injury and materially shortens the vaginal vault. It is far better to open the vagina, conserve its entire length, pass through into the vagina a gauze tape saturated with tincture merthiolate and close the mucosa by an inverted suture under direct vision. No added danger of infection will result from this procedure and the advantages are evident. There would be less objection to total hysterectomy from the standpoint of safety of the procedure, ease of accomplishment and adequate vaginal depth if this method were employed.

With closure of the mucosa of the vaginal vault, support is attained by suture of the uterosacral ligaments to the anterior vaginal wall fascia or the vesical fascia, re-enforced by overlapping of the round ligaments across the closed vaginal vault. With these supporting fascial and ligamentous structures properly applied, prolapse will not occur. The vault can be and is as well or better maintained than in subtotal hysterectomy. The entire field is covered by the vesico-uterine fold of the peritoneum, leaving a perfectly peritonealized pelvic floor. Sutures should only be placed where it is definitely seen

through what structures they pass. An improperly placed suture is the most common cause of bladder injury. It is our practice to sprinkle the field lightly with crystals of one of the sulfa drugs. The abdomen is closed without drainage. The vaginal tape of tincture merthiolate is removed immediately after the abdominal closure. An adequate restoration of the perineal floor should be done, if necessary.

SUMMARY

The indications for total hysterectomy are definite and have been emphasized. Cautery of the cervix and repair of cervical lacerations are not considered desirable if total hysterectomy can be safely performed.

The mortality of total hysterectomy is less than the incident of cervical stump cancer in properly selected cases under competent hands.

None of the serious objections often mentioned are encountered when the vaginal vault is well supported and length maintained. The right angle clamp below the cervix, across the vagina as an aseptic precaution seems inadvisable. It shortens the vagina. It is better to open the vagina and reconstruct the vault under direct vision, building up a firm support by the uterosacral ligaments, vaginal fascia and round ligaments.

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ABDOMINOPERINEAL PROCTOSIGMOIDECTOMY FOR CANCER OF RECTUM*

CONCLUSIONS BASED ON FIVE YEARS' EXPERIENCE

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RESTORATION of bowel continuity following resection has attracted the attention of surgeons here and

FIG. 1. Schematic drawing of incision with landmarks.

abroad ever since Reybard[1] more than a century ago successfully removed a sigmoidal cancer and immediately anastomosed the segments. Either by preservation of the sphincter musculature or by reestablishment of continuity, much progress has been made toward elimination of a colostomy for lesions of the rectum and pelvic colon.

The purpose of this discussion is to review an experience of over five years in a series of 461 cases of cancer involving the anus, rectum and pelvic colon and to appraise particularly the results obtained with the technic of "proctosigmoidectomy" as designed by Babcock in 1932.[2] In this group there were 265 males and 196 females, the extremes 17 and 85. The distribution was noted as shown in Table 1. Ninety-four and four-tenths per cent were reported as adenocarcinoma and 57.9 per cent were grade 11. Four hundred and twenty-four patients were operated upon,

an "operability rate" of 91.9 per cent. Radical extirpation was performed in 371 patients representing a "resectability rate" of 80.4 per cent.

TABLE 1

Sigmoid	58
Rectosigmoid	158
Rectum	231
Anus	14
Total	461

It will be noted that the rates of operability and resectability are based not on the number coming to operation but rather on the number of cases examined. If one were to exclude those who had been operated upon elsewhere but sought an opinion, inoperable patients who were referred to a roentgenologist for therapy or those who refused operation, it is obvious that the rates of both would be higher than is evident in Table 11. There were twenty-five deaths in 424 operations—operative mortality 5.8 per cent or twenty-three deaths in 371 resections—mortality from resection 6.1 per cent. If the various stages of multiple procedures are included, as well as preliminary enterostomies and closures, sphincteroplasties, removal of redundant bowel and the like, the 424 patients underwent eighty-two additional procedures or 506. On this basis the operative mortality is 4.9 per cent.

The disposition of the 461 patients is shown in Table 11.

Radical extirpation was performed in 371 of the 461 cases—a resectability rate of 80.4 per cent. The technic employed is shown in Table 111.

More and more has it been realized in our department that sigmoidal cancers, espe-

cially those low in the pelvic colon, can be widely resected with immediate end-to-end anastomosis, and similar lesions in the resections, 262 or 70.6 per cent were performed without an abdominal colostomy and of this number, 236 or 63 per cent
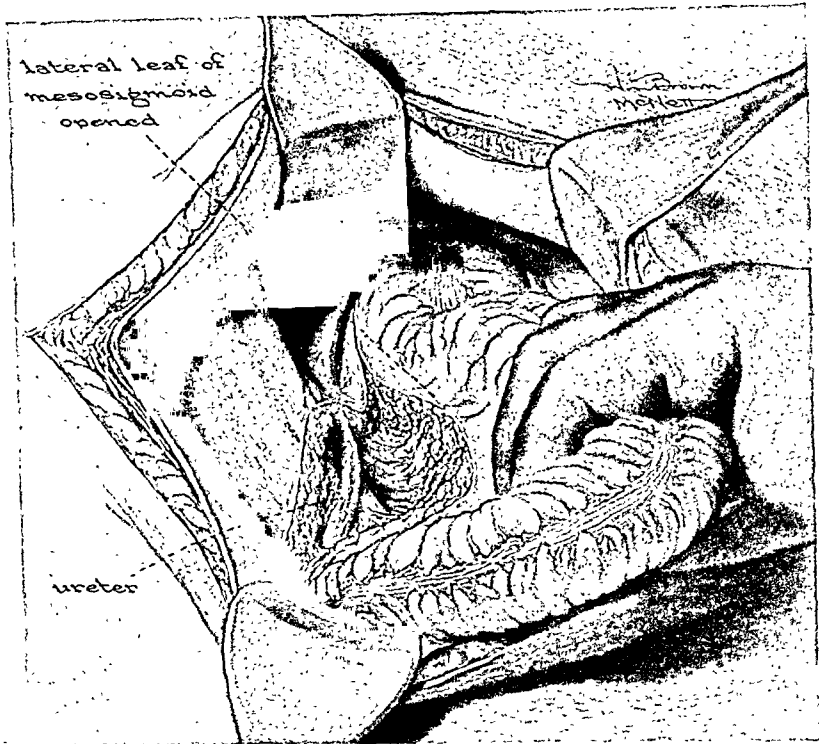
FIG. 2. Mobilization of sigmoid begun by incision of lateral leaf. Ureter is identified and retracted.

TABLE II

	No. Patients	No. Patients Operated upon	Operability Rate	No. Deaths from Operations	Mortality Rate from Operations	No. Patients Resected	Resectability Rate	No. Deaths from Resection	Mortality Rate from Resection
No procedure recommended	5								
Palliative colostomy	31	31		2	6.4				
Local excision (Bevan) alone or with radium implantation	14	14	......	..	0				
Exploration only	8	8	......	..	0				
Fulguration	21								
Refused operation or sought counsel elsewhere	11								
Resection	371	371	......	23	6.1	371	......	23	6.1
Totals	461	424	91.9%	25	5.8	371	80.4%	23	6.1

rectum can be removed without the establishment of an abdominal colostomy and with preservation of the sphincter musculature. It will be observed that of the 371 were operated upon by the technic of "proctosigmoidectomy."

It has become apparent that the views held by Miles[3] as to the lateral and espe-
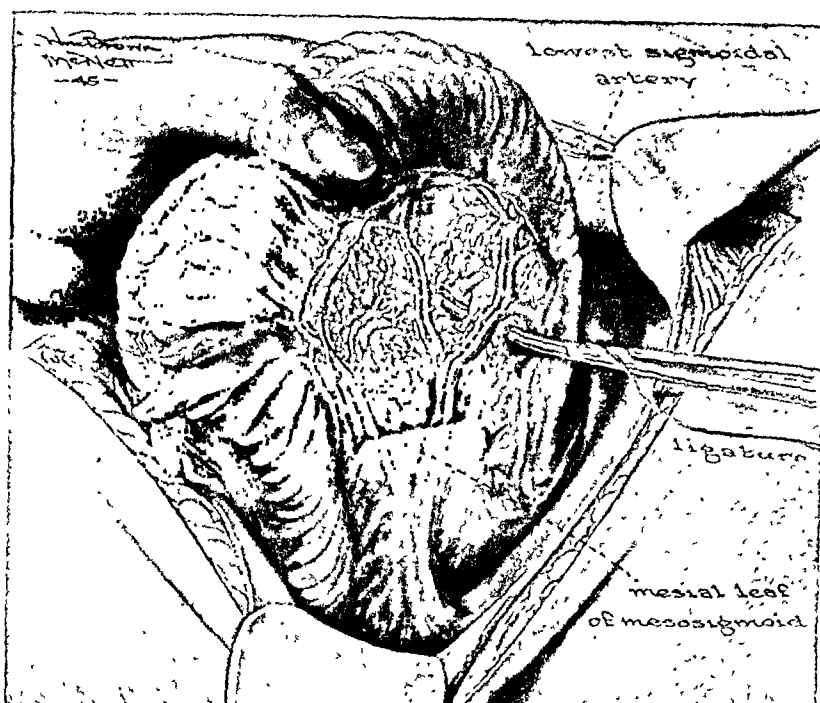
FIG. 3. Incision of medial leaf. Inferior mesenteric, left colic and sigmoidal vessels are shown and point of division.
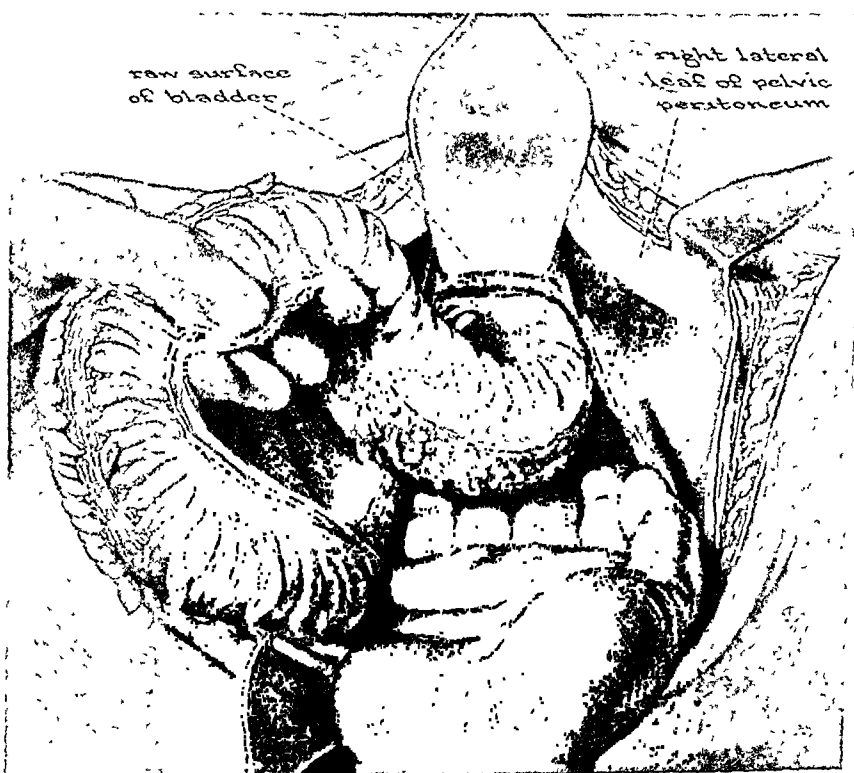
FIG. 4. Mobilization from abdominal phase is now complete. Hand is introduced into presacral space as far as sacrococcygeal articulation.

cially the inferior zones of spread necessitate some modification inasmuch as Westhues[4] has given striking evidence that cancerous connective tissue and lymph node metastases are located at the level of the carcinoma or above it. Dukes and Bussey[5] have confirmed these findings. Coller,[6,7] in his investigations found no evidence of retrograde metastasis to nodes situated 5 cm. below the primary site, and no metastasis along the lateral zone of spread where the inferior border of the lesion was 3 cm. or more above the mucocutaneous junction (anorectal line). It may be deduced, therefrom, that the inferior zone of spread is relatively unimportant.

TABLE III

	No Cases	Deaths	Percentage
Abdominoperineal proctosigmoidectomy—Babcock	236	15	6 3
Abdominoperineal excision—1 stage—Miles	51	2	3 9
Abdominoperineal excision—2 stage—Lahey	6	1	16 6
Sigmoidectomy—multiple stage—Mikulicz	27	2	7 4
Sigmoidectomy—primary anastomosis—Babcock or Furniss	24	2	8 3
Perineal excision with colostomy—Lockhart-Mummery	14	1	7 1
Anterior resection—Hartmann	9	0	0
Perineo-abdominal excision—Turner	2	0	0
Perineal excision—Cuneo-Seneque	2	0	0
Totals	371	23	6 1

The accompanying chart shows a group of forty-nine of seventy consecutive cases in which an abdominoperineal proctosigmoidectomy was performed. Dr. Ernest E. Aegerter, Professor of Pathology, personally supervised the serial sectioning of the postoperative bowel specimens at 2, 4 and 6 cm. below the growth. It will be observed that only in Case 3 was evidence of malignancy disclosed in each section; Case 20 showed malignancy at 2 cm. below the growth but not at other distance. In

other words, one of the forty-nine cases disclosed cancer at a distance of 6 cm. (2.0 per cent). It is our opinion that the
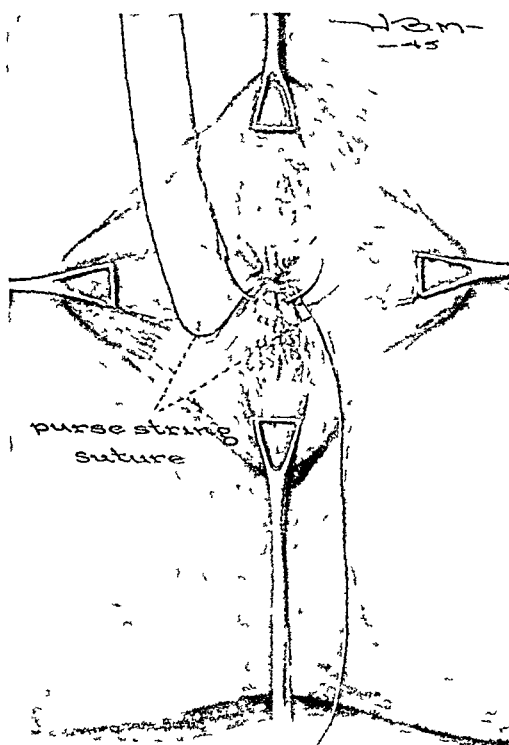
FIG 5 Purse string of stout silk introduced through the tough squamous epithelium of the anal wall immediately below anorectal line Ends are left long for traction

sphincter musculature may be preserved provided the lower border of the growth is 6-cm. or more above the anal margin.

Based on a series of 1,995 cases of malignancy of the anus, rectum and sigmoid colon, in which the precise location of the tumor was noted in 1,401 instances, the writer[8 9 13] found that only 10.2 per cent of lesions occurred within the distal 5.5 cm. of the bowel and 19.1 per cent were within the distal 8 cm. (above the anal margin). If all growths located in the distal 8 cm. area are excluded, 80.9 per cent occur in the situation above. In brief, 80 per cent of the cancers involving the distal loop do not necessitate sacrifice of the sphincter musculature.

It is obvious that preservation of the sphincter musculature does not jeopardize the radicability of the operation, for

TABLE IV

No.	Initials	Age	Sex	Type	Grade	Type of Resection	Cm. Bowel Removed	Circumference of Lesion	Section below Growth		
									2 Cm.	4 Cm.	6 Cm.
1	E. McR.	63	M	Adenoca.	II	AP.P.*	27	Entire	o	o	o
2	F. W.	62	F	Adenoca.	II	AP.P.*	25	1/4	o	o	o
3	W. O.	52	M	Adenoca.	II	AP.P.*	31	Entire	+	o	o
4	G. S.	55	M	Adenoca.	III	AP.P.*	26	Entire	+	+	+
5	T. D.	55	M	Adenoca.	III	AP.P.*	25	Entire	o	o	o
6	P. C.	39	M	Adenoca.	II	AP.P.*	43	1/2	o	o	o
7	E. R.	42	F	Adenoca.	II	AP.P.*	19	3/4	o	o	o
8	M. B.	66	M	Adenoca.	II	AP.P.*	22	Entire	o	o	o
9	S. L.	65	F	Adenoca.	II	AP.P.*	13	Entire	o	o	o
10	D. C.	36	F	Adenoca.	II	AP.P.*	21	Entire	o	o	o
11	P. G.	57	M	Adenoca.	II	AP.P.*	19	Entire	o	o	o
12	J. K.	58	M	Adenoca.	III	AP.P.*	30	Entire	o	o	o
13	S. A.	42	F	Adenoca.	II	AP.P.*	24	1/4	o	o	o
14	J. P.	52	F	Adenoca.	II	AP.P.*	10	1/8	o	o	o
15	J. R.	60	F	Adenoca.	II	AP.P.*	39	Entire	o	o	o
16	F. A.	58	M	Adenoca.	II	AP.P.*	19	Entire	o	o	o
17	M. D.	49	M	Adenoca.	II	AP.P.*	20	1/8	o	o	o
18	E. H.	74	F	Adenoca.	II	AP.P.*	30	Entire	o	o	o
19	E. S.	64	M	Adenoca.	IV	AP.P.*	30	3/4	o	o	o
20	E. V.	58	F	Adenoca.	III	AP.P.*	19	Entire	+	o	o
21	A. R.	72	F	Adenoca.	II	AP.P.*	28	3/4	o	o	o
22	E. H.	57	M	Adenoca.	II	AP.P.*	22	3/4	o	o	o
23	B. W.	38	M	Adenoca.	III	AP.P.*	16	3/4	o	o	o
24	L. W.	39	F	Adenoca.	II	AP.P.*	26	1/4	o	o	o
25	H. K.	62	F	Adenoca.	II	AP.P.*	29	Entire	o	o	o
26	B. O.	40	F	Adenoca.	II	AP.P.*	24	Entire	o	o	o
27	C. T.	58	M	Adenoca.	I	AP.P.*	25	1/2	o	o	o
28	J. B.	44	M	Adenoca.	II	AP.P.*	19	Entire	o	o	o
29	E. S.	72	M	Adenoca.	II	AP.P.*	21	Entire	o	o	o
30	R. B.	58	M	Adenoca.	II	AP.P.*	20	Entire	o	o	o
31	M. P.	65	F	Adenoca.	II	AP.P.*	26	Entire	o	o	o
32	A. K.	53	F	Adenoca.	II	AP.P.*	17.5	3/4	o	o	o
33	V. C.	60	M	Adenoca.	II	AP.P.*	19	3/4	o	o	o
34	C. B.	68	M	Adenoca.	II	AP.P.*	21	Entire	o	o	o
35	S. B.	56	M	Adenoca.	II	AP.P.*	24	Entire	o	o	o
36	V. L.	56	M	Adenoca.	II	AP.P.*	16	Entire	o	o	o
37	G. G.	61	M	Adenoca.	III	AP.P.*	30	Entire	o	o	o
38	J. F.	45	F	Adenoca.	II	AP.P.*	33	Entire	o	o	o
39	M. R.	59	F	Adenoca.	II	AP.P.*	20	1/2	o	o	o
40	A. V.	64	F	Adenoca.	II	AP.P.*	22	3/4	o	o	o
41	P. G.	41	F	Adenoca.	III	AP.P.*	14	Entire	o	o	o
42	G. McF.	73	M	Adenoca.	II	AP.P.*	20	3/4	o	o	o
43	L. K.	35	F	Adenoca.	II	AP.P.*	29	3/4	o	o	o
44	W. G.	66	M	Adenoca.	II	AP.P.*	24	3/4	o	o	o
45	J. C.	55	M	Adenoca.	I	AP.P.*	21	Entire	o	o	o
46	W. H.	41	M	Adenoca.	II	AP.P.*	17	3/4	o	o	o
47	A. DeG.	68	M	Adenoca.	II	AP.P.*	33	Entire	o	o	o
48	A. K.	55	M	Adenoca.	III	AP.P.*	22	3/4	o	o	o
49	H. T.	32	F	Adenoca.	II	AP.P.*	20	Entire	o	o	o

* Abdominoperineal proctosigmoidectomy.

Mandl[10,11] in a series of over 1,000 opera- tions found the percentage of three-year cures higher when the sphincter apparatus

patients on whom the writer performed an abdominoperineal proctosigmoidectomy, whereby, ninety may be classified as
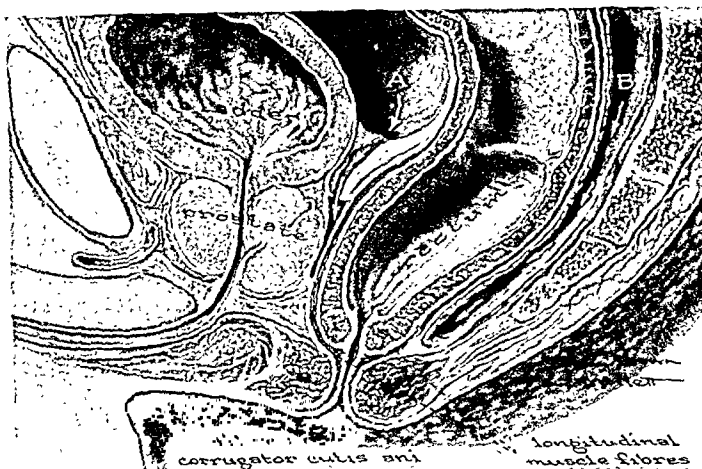
FIG. 6. Sagittal section through pelvis showing relationship of struc- tures and the extent of inferior mobilization by arrows from the ab- dominal phase A anteriorly, and B posteriorly. Note position of sphincters: I. S.—internal sphincter; E. S.—external sphincter and longitudinal muscle fibers.

FIG. 7. Sagittal section showing the position and relationship of musculature by traction on purse- string suture.

was preserved than when sacrificed. He maintains that similar results were obtained by Eichhoff (Kuttner Clinic) and by Pribam (Payr Clinic). The survival rate of our cases following "prostosigmoidec- tomy" slightly better than parallels the results obtained by the usual type of abdominoperineal extirpation.

Survival

Three years or more........... 58.6%
Five years.................... 50. %
(based on 81 cases)

After the method of David and Gil- christ,[14] we have analyzed 185 of our 236

FIG. 8. A, incorrect plane of cleavage; B, correct plane of cleavage.

"favorable" with no question as to re- sectability, and ninety-five cases in which one or more factors clouded resectability.

TABLE V

	No. Cases	Deaths	Mortality Per Cent
Abdominoperineal proctosigmoidectomy—no colostomy—sphincter muscles preserved	185	11	5 9
A. Favorable cases for resection	90	3	3 3
B. Doubtful cases for resection	95	8	8 4

The factors for which resectability was considered doubtful are appended in Table VI:

TABLE VI

Involvement of—small intestine (resection in all)   6
  Bladder (partial resection)....   6
  Uterus and adnexa (resection in all)   4
  Vagina (resection rectovaginal septum)   6
  Prostate (partial or complete resection in all)   6
  Ureter (partial resection in both)   2
  Abdominal parietes (wide excision)   1
                               31
Liver metastasis—1 to 5 small nodules   19
Age—70 or above   22
Adherence to sacrum   1
Transplantation of colostomy to perineum with resection   10
Transplantation of transverse colostomy to perineum with resection   1
Adiposity   9
Diabetes   2
Asthma   2
Bronchiectasis   1
Cholelithiasis—severe (cholecystecomy performed at time of resection)   1
Severe coronary disease   2
Double carcinoma of rectum and sigmoid   2
Ulcerative colitis   2
Concurrent adenocarcinoma with inflammatory (L.V.) rectal stricture   1
Multiple polyposis   1
                               76
                              107

Invasion of regional lymph nodes determined by microscopy was observed in sixty-seven cases or 36.2 per cent. It will be noted that the nodal involvement has not been grouped. Two hundred and twenty-one of the 236 patients survived this operation—a mortality of 6.3 per cent. The cause of death in the fifteen patients was peritonitis five, pulmonary embolism three, myocardial failure two, uremia one, diabetic coma one, pneumonia one, hemolytic transfusion reaction one and anesthesia one.

Preoperative Preparation. Except in the presence of obstruction, all patients are admitted to the hospital five to seven days prior to operation. A complete examination, including cystometric studies, is made and the patient placed in fluid, caloric, nitrogen and electrolyte balance. Unless contraindicated, a minimum of 2,500 to 3,500 cc. of fluid daily is consumed. Since 29.7 per cent of our patients with rectal and sigmoidal cancer showed hypoproteinemia during the preoperative period,[15] nitrogen equilibrium is established and maintained by a low residue diet in four feedings: Carbohydrate 400 Gm., protein 120 Gm., fat 50 Gm., and amino acids (casein hydrolysate reinforced with tryptophan) 300 to 400 cc. orally each day. One or more blood transfusions are administered in quantities sufficient to raise the erythrocyte count to four and one-half million. To assist in avoiding hemolytic transfusion reactions and their sequelae, sodium bicarbonate sufficient to maintain a urinary hydrogen ion concentration above 7.0 is given. Routinely, by mouth, thiamin chloride 50 mg., nicotinamide 100 mg., ascorbic acid 100 mg., and pyridoxine 5 mg. are prescribed daily. On the third preoperative day 1,000 mg. of sodium ascorbate is prescribed and for each day thereafter until operation. On the fifth preoperative day a non-absorbable sulfonamide is begun by mouth and continued to the morning of operation. Succinylsulfathiazole is given in an initial dose of 0.5 Gm. per kilogram weight, followed by a dosage of 0.25 Gm. per kilogram every four hours. More recently, phthalysulfathiazole, a sulfonamide having a similar mode of action, has been used in 119 cases, including eighty-two proctosigmoidectomies. The initial dose is calculated on the basis of 0.1 Gm. per kilogram weight; the maintenance dose is estimated upon the same basis. Castor oil, 40 cc., is given on the evening of the second preoperative day. The following day (first preoperative), the patient receives glucose

in water every hour and amino acids to total 2,000 calories. On the morning of operation, the rectum is irrigated until clear ment, all patients submitted to radical extirpation routinely receive 500 cc. of whole blood during the operation, and if
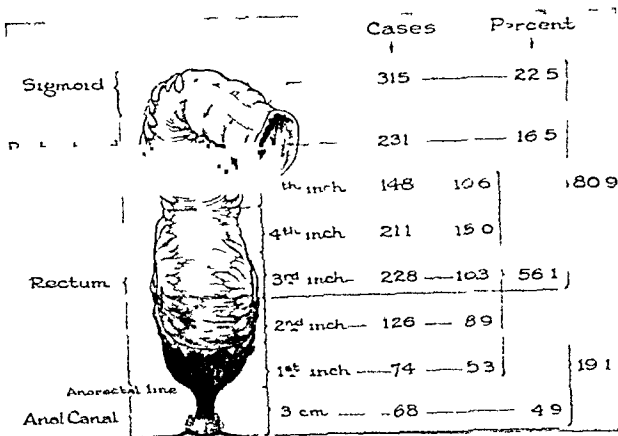
Fig 9 Distribution of cancerous lesions occurring in the anus, rectum and sigmoid. The sphincter muscles must *not* be preserved where lower edge of growth is within 6 cm. of anal margin
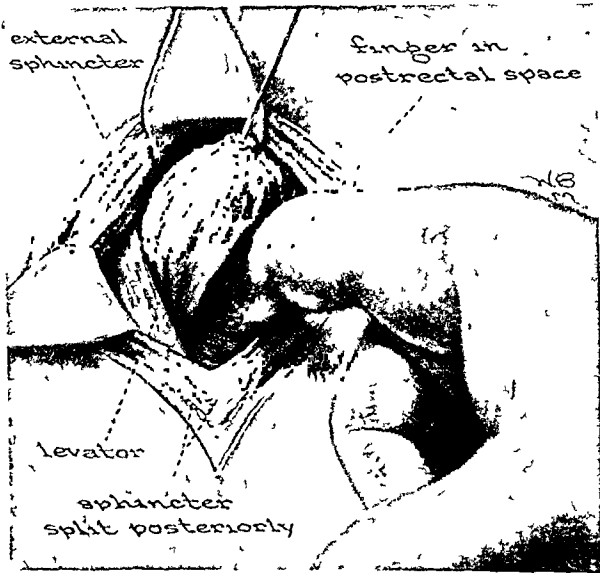
Fig 10. Mobilization of lower rectum.

and the residuum aspirated; amino acids and glucose in physiologic saline are administered intravenously and continued during the operation with 500 cc. of whole blood. An indwelling (Foley) catheter is inserted into the bladder.

Care during Operation. Our choice of anesthesia is fractional or continuous spinal, using 0.3 per cent pontocaine in 7 per cent dextrose solution. In our depart-

such is not obtainable, plasma or gelatin is substituted. As can be appreciated, the circumstance of a suddenly depleted blood volume calls for immediate replenishment, and the quickest and best means to increase blood volume is by direct infusion of blood.

Operation. Abdominal Phase: The abdomen is opened through a left oblique incision 3 cm. above the inguinal ligament, beginning at a point medial to the anterior

superior iliac spine and ending to the right of the midline above the pubic spine. Ordinarily, the left anterior rectus sheath is
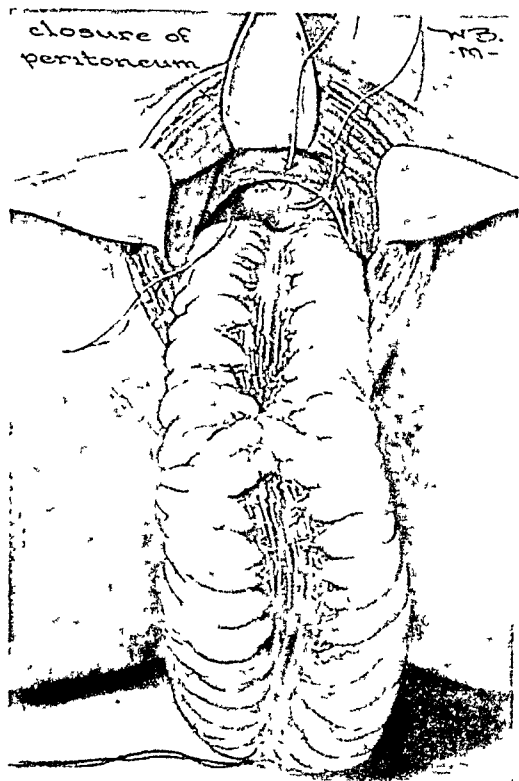
FIG. 11. Mobilization completed; anterolateral floor or pelvic diaphragm established by suture.

divided and, in a few instances, we have detached both the rectus and pyramidalis muscles from the pubic spine as suggested by Cherney.[16] The liver is examined for metastasis; the median lumbar, upper and lower mesocolic areas palpated for nodules, and the extent of the growth determined. The patient is placed in the Trendelenburg position and the pelvic cavity cleared of small intestine by hot packs. The left lateral leaf of the mesosigmoid is freely divided wide of any malignant infiltration, the incision being carried downward to the rectovesical or recto-uterine sulcus. In the course of the dissection, the left ureter, iliac and the spermatic or ovarian vessels are exposed. The spermatic or ovarian vessels may be divided and ligated. The sigmoid with attached fat and mesosigmoid is mobilized downward, continued around the

right pelvic brim and across the sulcus between the rectum and bladder or uterus to meet its fellow of the opposite side.

Ordinarily, transillumination is employed to visualize the inferior mesenteric, superior hemorrhoidal and sigmoidal vessels, and their communicating arcades. By such, greater precision can be exercised of those to be preserved, which is essential for that portion of the sigmoid to reach through the perineum. The necessary vessels, namely, the superior hemorrhoidal and lower sigmoidal, are clamped, divided, and doubly ligated. If desired, the lateral peritoneal leaflet of the descending colon may be divided in order to slide the bowel to a lower position. Having determined the point of viability by observing pulsating arteries or by the character of the bleeding when the small vessels on the surface of the bowel at the level of resection are incised, it is identified with black silk. By gently inserting the hand into the postrectal cellular space in the pelvis, the lower pelvic sigmoid and rectum can be stripped from the anterior surface of the sacrum as far as the sacrococcygeal articulation. The lateral ligaments are rendered prominent and divided; they may or may not require ligation. Anteriorly, in the female, the rectum is separated from the upper portion of the vagina, and in the male from the base of the bladder as far as the prostate. Care should be exercised to avoid injury to the seminal vesicles and vas deferens. Two and one-half Gm. of sulfathiazole powder are dusted over the viscera which is covered by the great omentum and the peritoneum closed. Interrupted sutures of No. 32 gauge alloy steel wire are introduced for fascia, and No. 35 gauge for skin.

Perineal Phase: The patient is changed to the lithotomy or inverted position on the specially designed spinal mattress and the rectum packed loosely with antisepticized gauze. The anal skin is incised circularly immediately distal to the pectinate or anorectal line. The sphincter muscle is identified, separated and retracted. Usually, a single transverse incision through the fascia

propria, which is closely adherent to the periosteum of the lower border of the sacrum, is all that is needed to mobilize the rectum posteriorly. By making traction on the bowel, the levator ani muscles are placed on the stretch, providing the lateral ligaments have been divided during the abdominal phase. The levators are clamped high, severed, and ligated. Anteriorly, the superficial and deep transverse perinei muscles are retracted. Cautiously the line of cleavage between the rectum and prostate is followed until the base of the bladder and the seminal vesicles come into view. In the female, the rectovaginal septum is

TABLE VII

	N.	Calories	NaCl.
1,000 cc. 10% glucose in N. sal. with....	....	400	9.0 Gm.
300 cc. Amino Acids (15% sol.).....	6.15 Gm.	180	
1,000 cc. 10% glucose in St. dist. water..	....	400	
50 cc. Sod. Lactate in 250 cc. St. Dist. water M/6 Sol......	....	14	
250 cc. whole blood (average)......	8.0	200	1.1 Gm.
250 cc. Blood plasma or Lyovac.....	2.4	61.5	1.5 Gm.
40 cc. St. dist. water with 2½ Gm. Sod. Sulfathiazole.........			
3,140 cc.	16.55 Gm.	1255.5	11.6 Gm.

separated by blunt and gauze dissection until the upper portion of the posterior wall and uterus are exposed. Mobilization being complete, the rectum and lower sigmoid are drawn through the wound and enclosed in a towel. The segment of bowel identified with black silk noting viability should protrude well beyond the skin margin. An anterolateral pelvic floor is established and the perinei and anterior sphincter muscles are permitted to assume their normal position. A curved, perforated, metal drain is inserted posteriorly along the

sacrum to evacuate blood and serum during the first forty-eight hours. Dressings are applied; the extruding bowel slit at point of or above viability (5 to 7 cm.) to allow for retraction, and a No. 28 gauge rubber tube placed and tied in the bowel. This rubber tube is removed after the first bowel movement, usually the third or fourth postoperative day.

Postoperative Treatment. Whole blood given during the operation is followed by 5 per cent glucose in isotonic saline solution; additional blood and plasma are administered if there is any doubt as to their need. Inhalation of high concentration of oxygen is given for a minimum of twenty-four hours for the purpose of effecting a reduction in the amount of nitrogen, thereby diminishing intestinal distention. Wagensteen suction is in force during the operation to avoid vomiting and regurgitation of vomitus into the lungs, and is continued for forty-eight hours or more.

It is of utmost importance to determine the patient's status as to hydration and acid-base balance. Dryness of the skin, thirst, and capillary turgor, but especially the urinary output per twenty-four hours, vaporization from skin and lungs, comparison with preoperative fluid balance and blood studies; the plasma protein, specific gravity of blood plasma and whole blood, the cell volume of venous blood by means of the hematocrit and the McClure-Ulrich test for tissue avidity are helpful indices, while the total serum carbon dioxide content and serum chloride, the daily urinary chloride concentration, loss by perspiration, loss by duodenal suction and by the Babcock intra-abdominal sump drain, will assist in ascertaining the electrolyte status.

It must be realized that there is a period of approximately seventy-two hours following proctosigmoidectomy when parenteral administration must of necessity be employed if nitrogen equilibrium is to be maintained. In a series of 103 patients, 83 or 80.5 per cent were held in positive nitrogen balance after resection by the administration of whole blood, blood plasma, and

FIG. 12. Anterior closure is shown; curved perforated tube drain posteriorly in place. Ordinarily, the bowel is divided and the rubber tube introduced only after all sutures have been introduced and dressings applied.

FIG. 13. Perinei and sphincter anteriorly as well as laterally are permitted to assume normal position. Divided sphincter posteriorly is not approximated immediately; 5 to 7 cm. of viable bowel are permitted to protrude from anus to allow for retraction. (We have recently found that division of sphincter muscle posteriorly is unnecessary).

TABLE VIII

	Initials	Age	Sex	Type of Lesion	Day out of Bed	Day Discharged Following Resection
1.	M. B.	66	M	Carcinoma	7	12
2.	T. D	55	M	Carcinoma	6	12
3.	M. L.	59	M	Carcinoma	7	12
4.	G. M	55	M	Carcinoma	6	17
5.	J. B.	48	M	Carcinoma	8	11
6.	E. O.	64	M	Carcinoma	7	12
7.	J. W.	57	M	Carcinoma	7	16
8	E D	59	F	Carcinoma	6	12
9	P. K.	55	M	Carcinoma	6	12
10	L. M.	72	M	Carcinoma	8	14
11.	L. R.	52	M	Carcinoma	8	14
12.	D. M.	69	F	Carcinoma	6	14
13.	F. W.	62	F	Carcinoma	6	11
14	E. McR	63	M	Carcinoma	6	12
15.	A. S.	70	F	Carcinoma	6	11
16.	P. C.	39	M	Carcinoma	6	11
17.	E R.	42	F	Carcinoma	6	15
18	W. O.	52	M	Carcinoma	6	12
19.	T. C.	38	M	Carcinoma	8	13
20	T. F	69	M	Carcinoma	8	15
21	A R	72	F	Carcinoma	7	14
22.	E N.	38	F	Carcinoma	10	14
23	E K.	68	F	Carcinoma	9	12
24.	E E*	51	F	Carcinoma	13	19
25.	J. M.	63	M	Carcinoma	8	13
26.	B M.	52	F	Carcinoma	9	13
27.	M. L.	32	F	Carcinoma	9	12
28.	F. T	52	M	Carcinoma	8	13
29.	G. W.	60	M	Carcinoma	9	15
30	C. B	54	M	Carcinoma	10	17
31	A. H.	62	F	Carcinoma	9	15
32	R. F.	52	F	Carcinoma	11	21
33.	G B.	56	F	Carcinoma	10	18
34	C R.	44	M	Carcinoma	9	12
35	S. P.	55	M	Carcinoma	8	12
36.	M. M.	29	F	Carcinoma	8	11
37.	V P	58	F	Carcinoma	10	16
38.	H. S	51	M	Carcinoma	8	15
39	A H	64	M	Carcinoma	9	19
40.	M. M.	62	M	Carcinoma	7	12
41.	M T.	46	F	Carcinoma	7	18
42.	A. S	70	F	Carcinoma	9	20
43	G W.	70	M	Carcinoma	9	22
44	L. D	37	F	Stricture (L V)	9	13
45	M C	39	F	Stricture (L V)	10	16
46	E G	26	F	Stricture (L V)	6	14
47	L A	26	F	Stricture (L V)	6	11
48.	E M	25	F	Stricture (L V)	6	10
49	B S†	39	F	Stricture (L. V)	6	15
50	F R.*	45	M	Stricture (L V)	6	12
51.	A V.	64	F	Carcinoma	6	11
52	J. C.	55	M	Carcinoma	6	11
53	M. R.	52	F	Carcinoma	6	11
54	S K.	58	M	Carcinoma	6	12
55	A. McF	73	M	Carcinoma	9	18
56	S. S	64	F	Carcinoma	6	11
57	W H	41	M	Carcinoma	6	11
58	W. G	66	M	Carcinoma	6	12
59	L. K	35	F	Carcinoma	6	11
60	L L.	41	F	Carcinoma	6	11
61.	H. T.	32	F	Carcinoma	6	11
62	A DeG	68	M	Carcinoma	9	19
63	J F.	45	F	Carcinoma	6	15
64	G G.	61	F	Carcinoma	6	12
65.	C B.	61	M	Carcinoma	16	30
66	A K.	57	F	Carcinoma	6	12
67	W J.	35	M	Carcinoma	7	11
68	R. B	58	M	Carcinoma	6	11
69	J. H.†	56	F	Carcinoma	7	15

Average—out of bed—7.4 days. Average—discharge after operation—13 6 days.

* Resection and transplantation of colostomy to perineum
† Resection and transplantation of transverse colostomy to perineum

amino acids in liberal quantities. In other words, twenty or 19.5 per cent of the cases showed hypoproteinemia; levels of 6.5 Gm.

maintain fluid, caloric, nitrogen and acid-base balance, approximate the following: 1,000 cc. of 10 per cent glucose in phy-
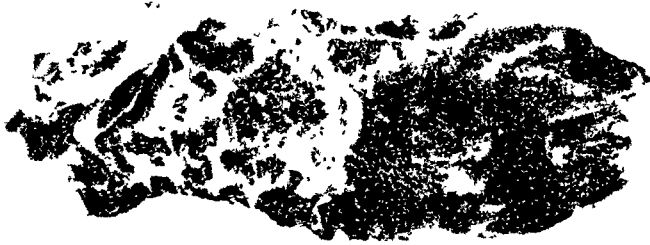
FIG. 14.
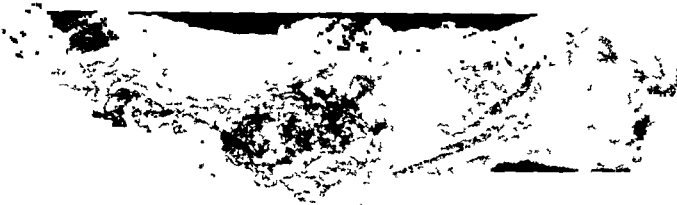
FIG. 15.

FIG. 16.

FIG. 14. Spec men following proctosigmoidectomy.
FIG. 15. Specimen removed following proctosigmoidectomy.
FIG. 16. Multiple polyposis with superimposed malignancy; removed by abdominoperineal proctosigmoidectomy.

per 100 cc. or above were considered normal. In contrast, however, were seventeen patients in whom no treatment was given. Of this number fifteen or 88 per cent became hypoproteinemic. Following resection, 2,500 to 4,000 cc. of fluid are given each day during the immediate postoperative period or until the patient can tolerate sufficient quantities by mouth. The amounts and values necessary to

siologic saline solution with 300 cc. amino acids (15 per cent solution); sodium lactate* (1-50 cc. ampule one-molar sodium lactate dissolved in 250 cc. of 10 per cent glucose in sterile distilled water represents a one-sixth molar solution and is equivalent

* The amount of sodium lactate needed is computed by daily estimation of the carbon dioxide content; e.g., Kilogram weight of patient $\times$ CO_2 deficit (65 vol. per cent accepted as normal) $\times$ 0.026 = the amount of $NaHCO_3$ in Gm.

to 8.4 Gm. sodium bicarbonate); sodium sulfathiazole, 2½ Gm. twice daily dissolved in 40 cc. of sterile distilled water;

FIG. 17. Specimen removed by proctosigmoidectomy.

blood plasma or Lyovac, 250 cc. daily, whole blood 500 cc. on first and third postoperative day.

Modern chemotherapeusis has been of value in preventing and combatting infection, especially peritonitis. Patients are given sodium sulfathiazole 2½ Gm. twice daily beginning the morning following operation. Guides are the urinary output, the blood sulfathiazole level, and the number of erythrocytes in the urine. Succinylsulfathiazole is given in suspension in the same dosage as before operation, namely,

0.25 Gm. per kilogram body weight every four hours as soon as the patient is able to tolerate liquids by mouth, usually on the third or fourth postoperative day. Phthalylsulfathiazole has been employed more recently. The drug is given postoperatively in amounts equal to the preoperative dose, namely, 0.1 Gm. per kilogram body weight every four hours in suspension as soon as liquids are tolerated by mouth. A definite decrease quantitatively of the coliform organisms has been noted by stool culture. In no instance have we encountered any untoward reaction.

Abdominal wound infection and dehiscence have been infrequent complications, in fact, in this series of 236 cases there were only two instances of abdominal wound infection 0.85 per cent. To a great measure, we believe that this has been due to the use of sulfonamides, to the maintenance of adequate protein and vitamin c levels, to the employment of the oblique muscle splitting incision and Babcock's alloy steel wire.[12]

Patients following proctosigmoidectomy are permitted out of bed usually on the sixth day, and during the past eighteen months the majority have been discharged from the hospital on the eleventh or twelfth postoperative day. It is worthy of mention that the presacral wound consumes about three weeks for complete healing and closure, approximately that of an ordinary anorectal fistula. Thus, the majority of our recent cases have been able to return to their former or perhaps lighter occupations in an average of six to ten weeks following operation. In our other types of abdominoperineal extirpations, in which a large perineal wound is made, at least three months was the average period required for healing.

It is rather difficult to estimate accurately the date of discharge especially with patients referred from distant cities who remain until transportation facilities are obtained or for similar reasons. Table VIII shows the day the patient is permitted out of bed and the day of discharge in a

recent group of patients in whom an abdominoperineal proctosigmoidectomy was performed.

perineal opening is more convenient and easier to care for and that evacuations are more satisfactory and less frequent.

FIG. 18. Specimen removed by proctosigmoidectomy and hemicolectomy. The transverse colon was transplanted to the perineum and sphincter muscles preserved. No. 49 in Table VIII out of bed on the sixth day.

Improvements and refinements in technic, such as establishment of an anterolateral pelvic floor, have prevented descent of small bowel into the perineal wound; precise maintenance of essential blood supply has avoided retraction and necrosis, and preservation of the sphincter musculature has offered continence in approximately 95 per cent of cases. Between 90 and 95 per cent are able to carry out their daily occupations without inconvenience. If one may judge from those patients in whom an abdominal colostomy was transplanted to the perineum, a perineal anus or anal sigmoidostomy is a distinct improvement over even a well constructed stoma in the abdomen.

Besides manometric methods for muscle contraction which is now being employed in our department, one means to evaluate the status of a perineal anus is to compare it with an abdominal colostomy in patients who have had both. To date, Babcock and the writer on their respective services have transplanted the abdominal colostomy to the perineum with or without resection in 84 cases with but one death (1.2 per cent mortality). These patients attest that they are more pleased, that the discharge of offensive gas is much less evident, that the

SUMMARY AND CONCLUSION

An experience of five years in a group of 461 cases of cancer of the anus, rectum and pelvic colon has been reviewed. An operability rate of 91.9 per cent and a resectability rate of 80.4 per cent are cited. Based on a series of cases as to location of growth, it may be deduced that in over 80 per cent of cancer in these parts, the sphincter musculature may be preserved. It will be noted that of the 371 resections, 262 or 70.6 per cent were performed without an abdominal colostomy and of this number, the technic of "proctosigmoidectomy" was employed in 236 or 63 per cent. The writer is convinced that this procedure has a definite place in the armamentarium toward combatting malignant disease. It permits radical removal of the cancerous bowel and gland-bearing areas and in spite of a high rate of resectability enjoys a low mortality rate (6.3 per cent in 236 cases); it allows early discharge of the patient from the hospital, reduces the period of wound healing, and affords early return to work.

It will be noted that following operation 80.5 per cent of the patients were held in positive nitrogen balance by the administration of whole blood, blood plasma and amino acids in liberal quantities. The use

of parenteral sodium lactate has proved helpful in protecting against renal complications from parenteral administration of absorbable sulfonamides. While peritonitis is the chief cause of death, non-absorbable sulfonamides, namely, succinylsulfathiazole and phthalylsulfathiazole, appear to have reduced the incidence. We have found that the customary three days for administration of these drugs is inadequate and recommend six days prior to operation given in dosage according to the kilogram weight of the patient.

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TRAUMATIC ANEURYSMS OF THE EXTREMITIES*

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IN 1941 and 1942 the author reported on the surgical treatment of peripheral aneurysm. Since that time while on duty with the U. S. Navy, fifteen more aneurysms, all of traumatic origin, have been surgically treated. All but two of this last group originated in combat. In peacetime as well, many aneurysms will arise from trauma, incident to auto and airplane travel resulting in injuries to major vessels. Those originating from gunshot and stabs of either accidental or criminal cause will continue. Hunting seasons give a proportionate increase in the numbers of these patients appearing for surgical treatment. The degenerating diseases such as syphilis and arteriosclerosis, while not of concern in this paper, are predisposing causes which trauma may precipitate. In such patients healing after trauma is delayed or is incomplete with the aneurysm as a result.

The traumatic aneurysm may be arterial or arteriovenous in type. Its origin usually is due to an incomplete severence of a major artery with the development of a pulsating hematoma and later a false sac. More rarely, complete severence not litigated or insecurely tied may cause the aneurysm, and in grossly infected wounds, slough above the site of a ligated vessel may result in leakage, clot development and eventual aneurysm formation. When the vein is involved in the injury, an arteriovenous fistula occurs. Attempts to differentiate between an aneurysm and a pulsating hematoma have been made, some observers reserving the former term for a well organized sac, whether of the so-called true or false type. The difference is merely in the length of time the pathological process has been going on, as the

pulsating clot surrounding a lacerated vessel will eventually develop a thickened sac and wall, provided it does not rupture first. In one recent article, it was stated that since many of these conditions subside spontaneously, operation should be reserved only for those which persist. With this we cannot agree. While occasionally a sufficiently thick wall may develop to obliterate the pulsation, one must remember that a fundamental characteristic of any aneurysm is to enlarge despite all surrounding structures. The aneurysmal erosion even of vertebrae is not unusual, and is an example of this characteristic.

While some aneurysms may develop directly after the injury, there may be a latent period while a clot temporarily occludes the laceration. After a time, from two weeks to six weeks, liquifaction of the clot occurs with a local hemorrhage, arrested by the surrounding muscles or fascia. Repeated episodes of bleeding occur with enlargement of the mass and the gradual development of a wall or sac made by the surrounding tissue. Clots laminate, organized and fibrose leading to a tumor mass. This mass will be expansile and pulsating depending on its size, the character of the surrounding walls, and the amount of liquid core. Other symptoms depend on whether the lesion is arterial or arteriovenous, and on its size and site.

In the *arteriovenous* type of aneurysm, if large and persistant, certain physiological changes occur. These are: (1) A fall in arterial pressure with a gradual recovery, the systolic pressure being higher and the diastolic lower, thus a greater pulse pressure; (2) an increase in the venous pressure;

(3) an increase in the pulse rate; (4) an increase in cardiac output, depending on the site and size of the fistula; (5) tem-

FIG. 1. Arteriovenous popliteal aneurysm Note enlargement of leg and intense collateral circulation development.

porary decrease in size of heart followed by an increase and hypertrophy of the heart; (6) increase in total blood volume; (7) development of collateral circulation around the fistula; and (8) if continued, cardiac failure.

Points six and seven are of therapeutic value, the operation being postponed, when this is feasible, until the collateral circulation is complete (three to six months) and in the large fistulas a phlebotery aids in reducing the increased blood volume at the time of the operation, and thus reduces the immediate cardiac load. Analysis of the venous blood will show higher oxygen content in the fistulous vein than in other veins. These veins are usually dilated. Pain depends on pressure on the nerves or sensitive parts.

In the *arterial aneurysms* there may be partial arterial failure distal to the an-

eurysm with diminished or absent peripheral arterial pulsations and decreased oscillometric readings. There may be weakness in the part, blueness and coldness. A tumor with thrill and bruit vary with the site and size of the aneurysm. Pain in all aneurysms depends on pressure of the sac on nerves or sensitive tissues, or on arterial failure to the part.

Operative treatment should be directed towards eliminating the aneurysm without interfering with the necessary collateral circulation. This may be done in one of the following ways:

1. In small aneurysms at times excision with end-to-end anastomosis of the vessel is feasible. By rerouting the vessel and flexing joints, a defect of 5 to 7 cm. can be bridged. This procedure was followed in one recent instance in the radial artery, with success.

2. A vein transplant occasionally can be used to bridge an arterial defect. If successful, the vein wall thickens, and in one examined some years later it was difficult to differentiate the vein from the artery.

3. In the arterial aneurysms, obliteration of the sac without its excision is the treatment of choice. After controlling the circulation above and below, the sac is incised, the contents evacuated, collateral openings into it sutured and the sac itself obliterated by implanting a contiguous muscle. In the popliteal area a section of the biceps or semi-membranosis can be utilized readily. The pectoralis major serves well in the axillary artery aneurysms. The sac retention prevents the division of the collateral vessels running near or in its wall. This fundamental surgical principle was originally demonstrated by Dr. Matas. Excision of the sac is the cause for most of the amputations in peripheral arterial aneurysms.

4. In a few of the arterial and in all arteriovenous types, the sac must be excised. All vessels entering the sac, arterial or venous, are resected and ligated with transfixion sutures. The sac is then excised. Retention of the sac in the arterio-

venous type may permit recurrence by leaving some small vessel continuity.

In all events, when the arterial circulation is divided, the accompanying vein, too,

Where plastic operation on the artery has been done, the anti-coagulants heparin and dicoumarol are necessary, and should be continued until the outcome is no longer in
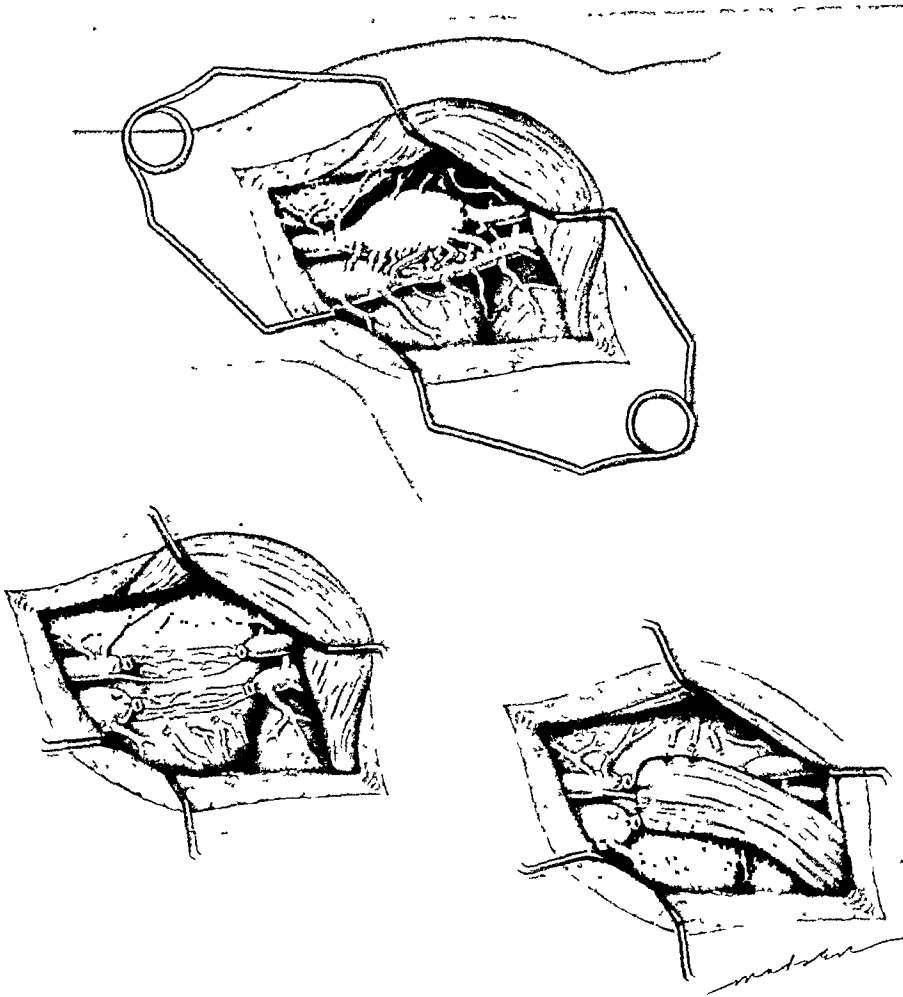
FIG. 2. Arteriovenous aneurysm; axillary artery; innumerable collaterals; excision of sac and muscle implant.

should be resected. There is 12 per cent less incidence of gangrene after ligation of the iliac artery if the accompanying vein also is sectioned.

AFTER-CARE

In all operations of this type repeated sympathetic nerve blocks are indicated and may save the limb, as the collateral circulation goes into a spasm at times. In some a sympathectomy is necessary to continue the block effect indefinitely.

doubt. The bleeding time should be maintained at or above fifteen minutes, and the prothrombin time (diluted) kept twice normal. Pressure areas should be prevented. A slight lowering of the foot of bed is favorable for the questionable circulation unless there is excessive edema. The question of warm or cold after operation is still debatable. An optimal temperature of 100° to 105°F. has been considered best to reduce collateral circulation spasm. The recent work on refrigeration has

caused many to use a cold cradle after operations on the theory that chilling reduces the oxidation of the extremity and thus it demands for blood supply. At present we use the warm cradle unless it is apparent that circulation cannot be restored.

Five patients with aneurysms were treated on one sixteen-day voyage on a U.S.N. Hospital Ship (U.S.S. Relief) in 1944 in the Pacific. These patients were brought aboard at New Calodonia for evacuation to the U.S.A., and were casualties from the battles of Pellelieu and Saipan. A brief review of their course is given:

CASE I. A twenty-two year old Army private had been shot by a Japanese machine gun twenty days before at Pellelieu. The wound was a through-and-through one in the left thigh with the point of entrance posteriorly three inches above the popliteal space and exit anteriorly at a slightly higher level. There had been occasional bleeding from the entrance wound. The foot was cool, and no pulse was felt in the dorsalis pedis or posterior tibial artery. On the first night aboard, the patient awakened to find his bed wet with blood. He called the nurse who saw no active bleeding, but before the medical officer arrived, a violent hemorrhage occurred, uncontrolled by a tourniquet applied immediately above the wound. A second tourniquet below the wound stopped the bleeding. Transfusions were ordered, and the patient taken to the operating room.

At the operation, a sloughing area of muscle and fascia was cleared away disclosing a partly divided femoral artery, with old and new clots surrounding it. Resection of the vessel had to be done some distance proximal and distal due to the necrosis. The clots were removed, the accompanying vein resected and the wound closed with implantation of the semi-membranosis muscle in the sac defect. A sympathetic nerve block with procaine was done at once. and repeated at six- to eight-hour intervals for thirty-eight hours. The circulation, while embarrassed, re-established itself and the wound healed primarily.

CASE II. An eighteen-year old private in the Marine Corps had a through-and-through wound of the thigh with a pulsating hematoma visible and palpable near the point of exit, and a tumor the size of a grapefruit. Exploration with evacuation of the clot and obliteration of the aneurysmal sac was done utilizing the adductor muscle group to close the sac. Imbrication sutures of silk were used. The circulation was re-established. Hemorrhage on the operating table was controlled only with digital pressure.

CASE III. A twenty-year old Corporal of the Marines was admitted with a diagnosis of multiple wounds. The right leg had been amputated eight inches above the knee by a guillotine type of procedure, with partial skin closure by two or three sutures. On the third day aboard, there was slight hemorrhage from the stump, and a pulsation of the expansile type was noticed. Shortly thereafter, a massive hemorrhage occurred controlled after the loss of a large amount of blood by tourniquet and manual pressure. The patient was operated on at once and a slough above the site of the femoral artery ligature was found to be the site of the bleeding. Because of the slough, the hemorrhage was controlled only by the insertion of a finger at the artery opening while dissection was continued to where there was normal vessel wall. The wound was then lightly drawn together. This stump healed rapidly thereafter, and the patient was on crutches when the ship reached the U.S.A.

CASE IV. A twenty-eight year old Corporal of the Army was admitted for transfer with a diagnosis of wounds, multiple, shrapnel received on Saipan. Among the wounds was one near the groin and on examination a pulsating tumor was noted. This was observed to be increasing in size slightly and on the sixth day at sea an operation was performed. The artery and vein were found involved in the aneurysm. The sac was the size of a lemon, and surrounding it were innumerable vessels connecting with it and with each other. These vessels could not be identified as either veins or arteries. They were obviously very immature, developing as collateral circulation, and bled on the least trauma.

Each vessel was ligated as it was encountered. Even with rubber tube control of the major vessels, frequent hemorrhage occurred during the procedure. Some of the vessels consisted of only a very thin layer and tore on any traction. The sac was excised with the tributory vessels. As in the others, sympathetic nerve blocks were

performed. The foot, at the completion of the operation was cyanotic, cold and appeared lost. The sympathetic nerve blocks were most effective in this patient, as after each one the circulation visibly improved. This patient was on crutches when the ship reached San Francisco.

CASE V. The last patient, a Marine private, also had the diagnosis of wounds, multiple, shrapnel received at Pellelieu. One leg had been amputated above the knee on the beach, and there were multiple wounds in the other leg. The high incidence of aneurysms caused a careful search for others, and this one was found only accidentally. It arose from the femoral artery of the unamputated leg and was expansile, and was approximately the size of an egg. There was a sinus leading to a shrapnel wound from which serous drainage exuded. Operation was performed electively as it appeared likely hemorrhage would occur. Both the femoral artery and vein were involved in the sac, and the sac, many collateral vessels, and a large section of the artery and vein were resected. With nerve blocks the peripheral circulation returned well, and a feeble pulse in the dorsalis pedis could be felt.

COMMENT

The occurrence of five aneurysms in a shipload of approximately 450 wounded was unusual, but an incidence of 1 per cent probably exists in traumatic wounds of the extremities caused by gunshot or stabs. The tendency to massive hemorrhage is characteristic, and in itself is an indication for operation. Where possible, the operation should be postponed for three to six months to permit adequate collateral circulation to develop, but where the wound is open or infected, delay is dangerous. Operation in such instance should be performed at the earliest facility where adequate instruments and surgical person-

nel are available. Two tourniquets should accompany transportation of such patients, and should be applied in event of severe bleeding above and below the site of bleeding. The sympathetic nerve blocks are an important part of the therapy, and may be the difference between success and failure in the surgical treatment.

After operative recovery, these patients should be treated like those with obliterative arterial disease, with emphasis on the developments of collateral circulation and care to prevent injury or infection of the part. These measures, briefly, are the abstinence from tobacco or other vasoconstricting drugs, use of sitz baths, avoidance of over-use of the limbs to prevent arterial supply failure, and the use of vasodilators such as whiskey and papaverine. Very careful foot hygiene with nail care is necessary, with prevention of skin breaks due to fungus infection, blisters or corns or inadequate-sized shoes and socks.

The operations described have been performed on fifteen patients since entering the Naval Service. In addition, I performed forty-two previous operations of similar nature. Since then 5 more operations have been successfully completed. In these sixty-two patients, no limb has been lost, although in one early operation for arteriosclerotic aneurysm, one little toe became gangrenous.

SUMMARY

1. Observations in arterial and arteriovenous aneurysms are presented.

2. A synopsis of five patients on whom operations were performed at sea on a U.S.N. Hospital Ship is given.

3. Surgical operations are discussed.

4. After-care is specified.

GENITAL TUBERCULOSIS IN WOMEN

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THE literature on this subject presents two constant and significant features. Most articles begin by stating the condition is a rare one, and then proceed to prove it is much more common than usually supposed. It appears the correct clinical diagnosis is rarely made, till the pathological specimen is examined microscopically in the laboratory. Greenburg,[1] in a review of 200 proven cases at the Johns Hopkins Hospital, gives the frequency as follows: 1 per cent of all gynecological cases, 8 per cent of all pathological Fallopian tubes, and one in thirteen cases diagnosed clinically as chronic pelvic inflammatory disease. The correct preoperative diagnosis was made in only 13 per cent of the series, and one-half of these had ascites and obvious tubercular peritonitis. Lahmann and Schwartz[2] studied twenty-one proven cases. In none of these was the correct diagnosis made or even considered prior to surgery, and in only one before examination on the specimen in the laboratory.

Obviously, the clinical picture is not sufficiently characteristic, nor sufficiently recognized to permit accurate clinical diagnosis, even by experienced clinicians. The writer's personal experience has been much the same. In a number of instances in which specimens had been sent to the laboratory with a pre- and postoperative diagnosis of chronic salpingitis or ovarian cyst, the surprising and humiliating report of tubercular salpingitis was returned. In a few cases this was of serious concern to the welfare of the patient. Three are of special interest:

CASE REPORTS

CASE 1. Mrs. B. W., aged twenty-three seen in the office March, 1942. She complained of severe pain in the lower right quadrant and of nodules on both legs. She was married at seventeen and had one normal full-term pregnancy, followed by vaginal discharge which cleared after office treatments. She had undergone sanatarium treatment for pulmonary tuberculosis and was discharged as arrested four years ago. Since then she has been well and active, menstruation regular and normal. A recent check up and x-ray study at the sanatarium gave negative findings. The general examination was negative; there was no evidence of fluid or masses in the abdomen.

On bi-manual examination a tender mass could be palpated in the right adnexa, apparently an ovarian cyst which had prolapsed behind the uterus. One did not get the impression of inflammatory disease and the diagnosis of tuberculosis was not considered in spite of the nodules on the legs which were recognized as erythema nodosum. Pulse, temperature and leucocytes were normal, and elective surgery was arranged. On exploration the upper abdomen was normal. In the pelvis the uterus was somewhat enlarged and on each side was found an inflammatory mass including the Fallopian tube and ovary with numerous typical tubercles on the surface, which gave us the correct diagnosis. There were no adhesions to bowel, bladder or omentum. It was possible to elevate the masses and to remove the entire focus of disease including both adnexal masses with the supracervical part of the uterus en bloc. There was no spill of contents or injury to other structures and the wound was closed without drainage. Hospital convalescence was afebrile and uncomplicated. The patient was advised to return to the sanatarium for observation. She was discharged after a few weeks of uneventful convalescence, and has since been carrying on her household duties.

In retrospect tuberculosis of the uterine adnexa should have been considered preoperatively. However, it is a question if this would have contributed to the welfare of

the patient. Such a suspicion would have introduced the idea of palliative measures and she would have continued to harbor a secondary focus of the disease with untoward possibilities. We were able to apply adequate therapeutic measures, fortunately at a favorable stage of the disease, namely, complete removal of the focus of infection. I can think of no other course of procedure which could have accomplished as much for the future welfare of this patient.

CASE II illustrates what may be accomplished under less favorable conditions. Miss A. B. aged twenty-five was referred by Nopeming Sanatarium because of recurrent abdominal pain and persistent distress. At that time the pulmonary diseases was arrested but the patient was incapacitated because of the abdominal condition. The appendix and right Fallopian tube had been removed ten years previously. At surgery the stump of the Fallopian tube was removed and also a chronically inflamed left tube with the cornua of the uterus, and the uterus was suspended. Convalescence was uncomplicated. The pathological report was tubercular salpingitis. This patient has since been under intermittent observation, and now fifteen years later is employed in defense work.

However, there is a reverse side to the picture, exemplified by CASE III. Mrs. O. O. B., aged thirty-four, first came to surgery in 1926 with a diagnosis of chronic salpingitis. Both tubes were removed and convalescence was uncomplicated. There was no mention of tuberculosis by the surgeon or pathologist. She was seen in October, 1927, because of recurrent pelvic pain and distress. There was a tender mass in the right adnexa and the impression gained was that of an ovarian cyst. At surgery the omentum was adherent to the ovarian cyst which was excised. There was no excess fluid in the abdomen, and the wound was closed without drainage. Convalescence was complicated first by an apparent massive collapse of the lung, and later by a femoral thrombosis. The patient was discharged apparently in good condition, but within a few weeks there was recurrence of abdominal distress, rapid deterioration and death. Autopsy disclosed diffuse abdominal tuberculosis and generalized miliary tuberculosis.

Evidently the lesion had been attacked at an unfavorable stage and had been inadequately handled. We had failed to recognize the local tuberculosis as such, and to exclude the presence of the disease elsewhere in the body. Accordingly, we undertook major surgery under general anesthesia in an individual already allergic or susceptible to traumatic spread of the disease. Furthermore, since we did not recognize the nature of the lesion, it was incompletely removed and local spread of the process was stimulated. While there may be a proper time and method of surgical treatment, there are also improper times and equally improper methods. There is need of more accurate information concerning these lesions and the criteria of safe and adequate therapy.

During the past fifty years, a rich and extensive literature on this subject has been developed. It is neither possible or proper to present a complete review of this material. The purpose of this presentation is to develop and offer the logical conclusions therefrom which will suggest essential principles governing the conduct of such cases.

Tuberculosis of the female genital organs is but a part or complication of a constitutional disease with the primary focus in the lungs. While theoretically possible, primary involvement of the cervix or lower genital tract is so rare that this form of the disease may be practically disregarded. The infection is carried in the blood to the mucosa of the Fallopian tubes which is the primary pelvic or peritoneal lesion. The only exception is in rare instances of intestinal tuberculosis which spread by continuity to the peritoneum and Fallopian tubes.

The primary pelvic lesion in the mucosa of the tubes undergoes the characteristic tuberculous processes: tubercle formation, caseation, necrosis and encapsulation, or spread in the lymphatics.

Extension takes place into the fundus of the uterus and to the opposite tube, the condition found in most specimens studied in the laboratory. This is the status by the

time the condition is evident clinically and therefore may be considered as the minimum of pathology to be treated. Involvement of the cervix and lower tract occurs by extension from the fundus but is a late and relatively infrequent occurrence. For practical purposes it must be assumed that involvement of these structures is accompanied by lesions in the fundus and tubes. Conversely, if the cervix is clear on inspection, subtotal hysterectomy will effectively remove the pelvic lesion. The process may extend by destruction and invasion through the wall of the Fallopian tube to the pelvic peritoneum, being the most frequent source of tuberculous peritonitis in the female. Furthermore, it has long been recognized that surgical cure of tuberculous peritonitis is possible, and only possible, by complete excision of the primary pelvic focus in the fundus and tubes.

Tuberculosis of the pelvic structures occurs in a large percentage of women with advanced pulmonary lesions. Most of these are of only academic interest and present no therapeutic problem. Also, and most important, it occurs as a late complication in women who have recovered from the pulmonary lesion, and in those who present no clinical evidence of the original process. In such individuals it is often the only active focus of tuberculosis in the body. Its successful excision is practically possible by adequate surgery and will be of real service to the patient. On the other hand, unsuspected presence of pulmonary lesions, or active sensitization to the disease, may impose forbidding obstacles to successful surgical attack.

Clinically, the condition may present one of several pictures: Advanced with peritonitis, ascites and constitutional reaction which suggest tuberculosis, but with no evidence of pulmonary disease. For this condition, Hegar, in 1886, demonstrated successful results by radical surgery. In 1890, Osler[3] discussed the advantages and limitations of surgery in treatment of pelvic and peritoneal tuberculosis. Howard Kelly[4] reported successful results in a few cases.

Later J. B. Murphy[5,6] presented his exhaustive study of pelvic tuberculosis and W. J. Mayo[7] made several contributions advocating adequate surgical treatment of tuberculosis peritonitis. As long as forty years ago, the possibilities and limitations of surgical treatment for this type of pelvic tuberculosis had been well formulated and accepted. In this type of disease the clinical picture is usually sufficiently clear to permit preoperative diagnosis and deliberate choice of treatment.

The less advanced stages of the disease present no characteristic symptoms or signs, and the condition is usually unsuspected till the surgical specimen is studied microscopically. The exhaustive mongraph of J. Whitridge Williams[8] is the basis for our information on this subject. Numerous subsequent studies have confirmed his findings and all together give us the picture of these lesions.

One type of the disease gives rise to chronic inflammatory changes in the Fallopian tube and adnexa, resulting in masses of varying size which may be mistaken for pelvic tumors. There is no febrile reaction or severe local tenderness so the clinical diagnosis is likely to be some type of pelvic tumor or chronic pelvic inflammatory disease at a quiescent stage. There is nothing to suggest tuberculosis, unless one thinks of it and deliberately seeks for suggestive evidence. A positive skin reaction is proof only of a lesion somewhere in the body. History or previous pulmonary tuberculosis or exposure should arouse suspicion. Early in the course of the process the endometrium of the fundus is involved and study of curretage specimen may give the diagnosis.

In other individuals, the tuberculous process is quite inactive but is found accompanying some other obvious lesion, fibroid, ovarian cyst, etc. Such involvement is discovered only at laporotomy, or more often by the pathologist when the specimen is examined in the laboratory. In a few instances the untoward effects of anesthesia or of surgical trauma will be sufficient to

cause exaccerbation of such a quiescent process with widespread dissemination of the disease.

From the available evidence one must conclude that tuberculosis of the female genital organs should be considered in the clinical diagnosis of pelvic disease as presented to the surgeon, since it is found in from 2 to 8 per cent of all such pathological specimens. This is important (1) to avoid surgery at an unfavorable time or in the presence of unrecognized pulmonary disease; (2) so that the surgeon may recognize the nature of the lesion and carry out adequate measures, namely, the removal of all diseased tissue.

Numerous reports in the literature give abundant proof that under favorable conditions such lesions may be attacked surgically without undue risk. The early reports of Hegar followed by those of Osler, Kelly, and Williams established the possibilities of surgical treatment and were soon supported by the studies of Murphy and W. J. Mayo. More recent reports by Ruben Peterson[11] Greenburg[1] and Haas[13] demonstrated the efficacy and safety of suitable surgery in this type of disease. With proper preoperative study and screening to eliminate cases with unfavorable complications, the surgical risk is not greater than for elective procedures in women of similar age except for certain contingencies: (1) The tuberculous lesion may be adherent to the bowel or bladder and careless handling may cause a fistula. (2) Drainage is to be avoided since secondary infection may result in a persistent sinus. (3) Incomplete excision of the tuberculous lesion will leave a focus for spread of the disease and exaccerbation of the process.

In this connection, one must remember that the pelvic lesion involves both tubes and the fundus of the uterus. The cervix is involved late in the process, likewise the ovaries. Therefore, adequate excision should include subtotal hysterectomy with both tubes unless the cervix is known to be involved. If the ovaries are grossly normal, they may be left at the discretion of the surgeon.

CONCLUSION

1. Tuberculosis as a cause or complication of pelvic disease must be given serious consideration in the clinical study of women patients.

2. Tuberculous peritonitis is usually due to lesions in the Fallopian tubes and can be cured by removal of the pelvic focus of disease.

3. This includes the fundus of the uterus and both tubes, all of which must be removed.

4. After surgery these patients should be kept under expert observation to detect any possible recurrence of the pulmonary disease.

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BILATERAL PETIT'S HERNIA AND AN ANTERIOR SACRAL MENINGOCELE OCCURRING IN THE SAME PATIENT

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THE case which we are presenting is of interest for a number of reasons. The patient was a woman who displayed bilateral congenital Petit's hernia and had in addition a large pelvic menigocele. Both lesions proved amenable to surgical intervention. Repair of the huge Petit hernia on the right side was accomplished with the use of sutures of fascia lata; the meningocele had been removed at an earlier abdominal operation.

Hernia occurring in the lumbar region may present through Petit's triangle or the Grynfeltt-Lesshaft triangle. More rarely there have been described hernias through Hartmann's cleft or through the hiatus of the lumbar spinal nerves as reported by Braun.

The inferior lumbar triangle had been described by Garengeot in 1731 and by others prior to Petit. Petit, in 1733 or 1738, reported a strangulated hernia presenting through this anatomic triangle, which has since been known as Petit's triangle. The boundaries of this triangle are the iliac crest below, the latissimus dorsi muscle posteriorly and the external oblique muscle anteriorly. The floor of the triangle is composed of the lumbar fascia overlying the internal oblique muscle, beneath which lies the transverus abdominis muscle. Watson found the normal reported height of the triangle to range from 1 to 7 cm. and the width across the base to vary from complete absence to 6 cm. Lesshaft dissected 108 adult and thirty-five infant cadavers. He found Petit's triangle to be present in 77 per cent of the adult and in 25 per cent of the infant cadavers. Goodman and Speese found Petit's triangle to be present in 63 per cent of their seventy-six dissections.

Petit's triangle is not to be confused with the superior lumbar triangle described by Grynfeltt in 1866 and Lesshaft in 1870. The latter triangle lies above and anterior to Petit's, and its boundaries are the twelfth rib and a portion of the lower border of the serratus posterior inferior muscle for a base, the edge of the internal oblique muscle for the anterior border and the edge of the sacrospinalis muscles for the posterior border. The latissimus dorsi muscle serves as a roof while the transversus abdominis muscle and fascia form the floor of the triangle.

INCIDENCE AND ETIOLOGY

Up to 1902 von Baracz could find but sixty-eight records of true lumbar hernia and only three of these stated the exact anatomic site. In 1924, Watson made an exhaustive review of the subject and found 115 lumbar hernias reported in the literature; of these thirty each were recorded to have occurred through Petit's and Grynfeltt's triangles. Watson found the following statistics for the entire group of 115: the age of patients ranged from two to eighty years, half of them being less than fifty years of age; the ratio of male to female patients was 2.7 : 1. He found that Petit's hernia presented predominantly on the left side in a ratio of 2.5 : 1, being bilateral in only one case. The 115 cases could be classified on an etiologic basis as follows: congenital (eighteen cases) 15.7 per cent, spontaneously acquired (sixty-five) 56.5 per cent, acquired traumatic (twenty) 17.4 per cent and unknown (twelve) 10.4

TABLE I
PETIT'S HERNIA: SURGICAL CASES

Author	Patient Sex	Patient Age Yrs.	Side	Size of Defect	Cause of Hernia	Symptoms	Repair
Owen 1888	F	5½	L	Admits thumb	Lumbar abscess		Inverted sac; catgut repair of muscles
Bull 1894*		1¾		Admits thumb	Congenital?		Excised sac; kangaroo tendon for deep structures
Raymond 1897	M	35	L	One finger-breadth	Wound in side		Sutured latissimus dorsi to external oblique
Jones 1902	M	45	R		Old scar present	Pain; constipation	Silkworm gut in latissimus dorsi and external oblique
Lejars 1905.	M	65	L	Sac 7 cm. in diameter		Pain; constipation	Excised sac; 3 sutures to close edge of muscular ring
Dowd 1907	M	3½	R	Larger than palm	Congenital		Excised sac; gluteus maximus and medius flap over defect
Medical Division of Prussian Ministry of War[24,27] 1913.							No sac; sutured latissimus dorsi to external oblique
Rishmiller 1917	M	36	L		Chip fracture of crest of ilium	Soreness, interfered with defecation	No sac; flap split from aponeurosis of latissimus dorsi
Turner 1917	M	55	L	Two finger-breadths	Fall	Pain in loin	No sac; mattress sutures in muscle (penetrated bowel)
Hancock 1920	M	40	L		Fall		Sutured external oblique to latissimus dorsi muscles
Maidagan 1922*	F	13	L	Two finger-breadths	Abscess		Excised sac; sutured latissimus dorsi to external oblique
Sias 1937	M	27	L	Hernia size of pigeon egg	Followed jumping off a wall 4 meters high	Pain over hernia	No sac present. Sutured transversus abdominis and internal oblique in separate layers followed by approximation of external oblique and latissimus dorsi muscles
Pavcovich. 1942	M	68	R and L	Small	Associated with lipoma	Pain in loin	Chromic catgut no. 2 in latissimus dorsi and external oblique muscles
Kapsinow 1943	M	48	L	Admits two fingers	Lifting	Dull pain	Excised sac; Dowd's technic
Stubenbord 1944	M	23	L			Severe pain in loin	No sac; chromic catgut in latissimus dorsi and external oblique
Masson 1945	F	42	R and L	5 inches in diameter	Congenital	Constipation; two attacks of severe pain	Sac was not opened; repaired with fascia lata sutures

* Probably a Petit hernia.

per cent. Von Baracz earlier had listed an additional factor of local suppuration and formation of abscess as a cause in 7.6 per cent of the cases on which he collected data.

Sillman reviewed seventy-eight cases of lumbar hernia in 1925 and found that in

REVIEW OF PREVIOUSLY REPORTED CASES OF SURGICAL TREATMENT OF PETIT'S HERNIA

In fifteen previously reported cases Petit's hernia (Table 1) has been submitted to surgical repair. In 1888, Owen reported

TABLE II
CASES OF LUMBAR HERNIA ENCOUNTERED AT THE MAYO CLINIC

Case	Patient Age, Yrs.	Sex	Side	Cause	Size	Duration, Yrs.	Site
1	71	M	R	Spontaneous	Small	..	Petit's
2	38	F	R	Observed after automobile accident and injury to left hip	Orange	13	Petit's
3	73	M	R	Spontaneous	Small	..	Petit's
4	75	M	R	Spontaneous	Orange	3	Petit's
5	42	M	R	Site old stab wound	Good size	3	Lumbar
6*	47	M	R	Site old stab wound	¾ inch hiatus in lumbar aponeurosis	..	Lumbar
7*	48	F	R	Injured right side of back while pregnant	3 inch at neck of sac	20	Lumbar

* Surgical treatment was carried out.

eight cases (10.3 per cent) the hernia was strangulated. Eighteen of the seventy-eight patients were treated surgically. Watson reported that in 11.3 per cent of his reviewed cases the hernia was strangulated.

SYMPTOMS AND DIAGNOSIS

The symptoms of Petit's hernia are essentially those of hernia elsewhere; that is, presence of a mass located above the iliac crest, which may or may not be entirely reducible and which transmits a cough impulse. Dyspepsia and constipation are frequent symptoms. Many patients complain of a sense of local pressure or pain. Straining or heavy lifting may initiate the development of the hernia while in other cases the enlargement is gradual with an absence of etiologic factors. Often there is a history of trauma or local infection.

One must consider the presence of a lipoma, fibroma, fluctuant cold abscess, hernia of muscles or hematoma in the diagnosis of cases of lumbar hernial masses.

the first repair. He approximated the muscles with catgut. In 1894, Bull used kangaroo tendon. In 1907, Dowd formed a flap from the aponeurosis covering the gluteus maximus and medius muscles and turned it up over the defect. In 1917, Rishmiller made a flap from the aponeurosis of the latissimus dorsi and covered the defect with this flap. Kapsinow used Dowd's technic. In the remaining cases the defect was small enough to be obliterated by simple approximation of the latissimus dorsi to the external oblique muscle. The size of the defect ranged from very small to one larger than the palm of the hand. In five cases the sac was excised. It was inverted in one case and in five cases no sac was present. Great caution should be exercised in entering the sac because of the intimate relationship of the large bowel and the kidneys and ureters to the sac. Turner penetrated the colon in such an attempt.

In only two of the thirteen previously reported cases in which the sex of the

patient was stated was the patient female and in but two of the twelve cases in which the cause of the hernia was stated was the

the result of senile degenerative changes in the tissues, perhaps associated with a previous weakness in this region.

FIG. 1. Specimen showing anterior sacral meningocele, uterus and left tubo-ovarian abscess.

hernia congenital. Bilateral hernias were present in one case. The hernia occurred on the left side in ten of the thirteen cases in which the side was stated. Pain or soreness over the hernia was a symptom in eight cases.

LUMBAR HERNIA ENCOUNTERED AT THE MAYO CLINIC

Only seven cases of true lumbar hernia have been encountered at the Mayo Clinic prior to the case reported in this paper. All of the hernias were reducible and only one patient complained of discomfort. In four cases the hernia was considered to be Petit's hernia while in the remaining three it was classified as lumbar hernia. Table II presents data on these seven cases. In five of the cases the hernia was asymptomatic and surgical treatment did not seem necessary. A history of trauma was present in four cases; in three cases the hernia occurred spontaneously. The spontaneous hernias occurred in patients more than seventy years of age and were probably

In one of the two cases in which surgical treatment was carried out a ¾ inch (2 cm.) hiatus in the lumbar fascia produced by an old stab wound was closed with chromic catgut after the sac had been excised.

In the second case a 3 inch (8 cm.) opening in the lumbar region was closed with two rows of chromic catgut and seven strips of fascia lata each 8 inches (20 cm.) long. The sac contained ascending colon and was inverted. This patient had been injured in an accident in 1918, following which a Petit hernia developed. Four attempts at repair had been made prior to her admission to the clinic. Three years after the repair of the hernia at the clinic a small recurrence was reported by correspondence.

ANTERIOR SACRAL MENINGOCELE

Anterior sacral meningocele is a type of spina bifida in which there is usually a defect in one-half of the sacrum, through which a meningeal hernia presents. Occasionally, elements of the spinal cord or

nerves may be present in the hernial sac, the lesion then being designated a meningomyelocele.

Coller and Jackson reviewed the literature in 1943 and found a total of twenty-three cases to have been reported. In 1938,

of deaths resulting from meningitis. In eleven of the cases the result is reported to have been satisfactory but in two cases there was no improvement.

Anterior sacral meningocele occurs more frequently among female than among male

FIG. 2. Pelvic roentgenogram showing the right sacral defect.
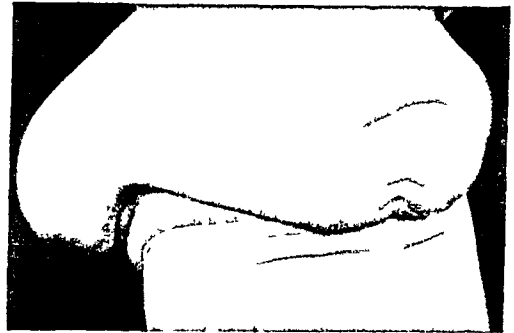
FIG. 3. Anterior view of patient before repair of the right Petit hernia.

patients in the ratio of 24:4 in the reported cases. Coller and Jackson found that the lesion usually manifests itself in the first

FIG. 4. Posterior view of patient before repair of the right Petit hernia.

FIG. 5. Posterior view of patient after repair of the right Petit hernia.

Adson reported a case, not included in Coller's series, in which successful operation was performed by the posterior approach. Shidler and Richards reported three additional cases, in one of which they operated successfully by the posterior approach. Our case brings the reported cases to a total of twenty-eight. In twenty-one of the twenty-eight cases surgical treatment has been carried out with a mortality rate of 38 per cent, the majority

three decades of life. The meningocele enters the pelvis through a congenital anterior sacral defect, more often on the right side than on the left. They stated that the diagnosis rests on the triad of a lifelong history of constipation, a retro-rectal tumor mass and roentgenologic evidence of a sacral defect. However, one must also consider the possibility of a retroperitoneal dermoid, lipoma, chordoma or an ectopic kidney.

The first successful operation for anterior meningocele, performed in 1903 by Pupovac, was carried out by the posterior ap-

CASE REPORT

The patient, an American born, white woman, forty-one years of age, was first examined at
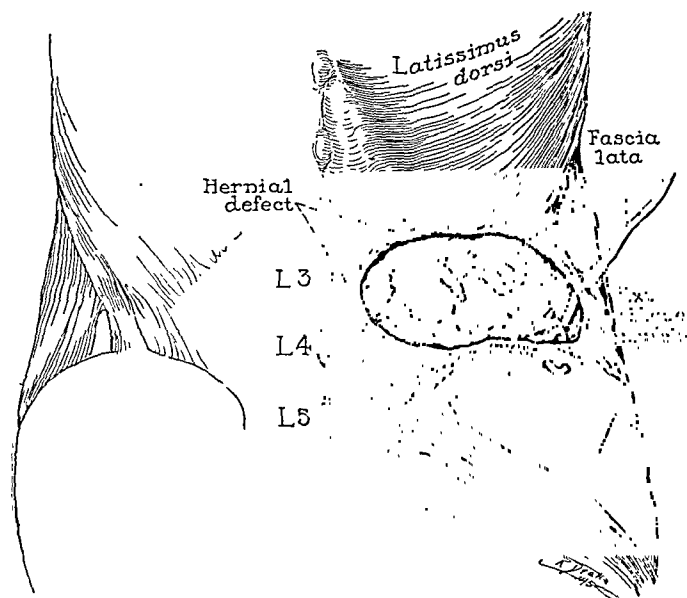
FIG. 6.
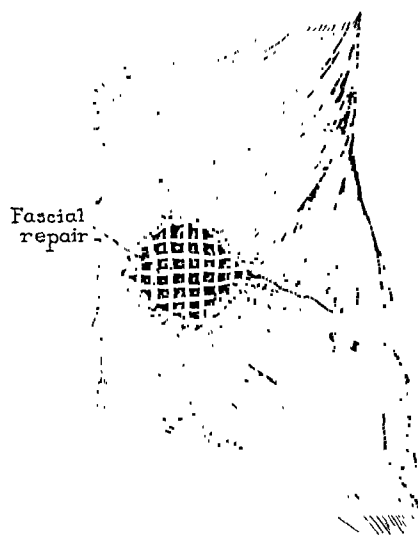
FIG. 7.

FIGS. 6 and 7. Repair of hernia with fascia lata by anchorage to iliac crest and to the transverse processes of the third and fourth lumbar vertebrae.

proach. Coller and Jackson stated that the abdominal approach had been used in four cases, in one of which the outcome was fatal.

An examination of the records of the clinic reveals that only three cases have been encountered in addition to Dr. Adson's case and our own. In 1915, Dr. C. H. Mayo performed an abdominal drainage type of operation on an anterior meningocele. The patient, a girl, was then twenty-two months of age; she lived long enough for a teratoma to develop in the pelvis at the age of twenty-three years. Dr. Judd removed a small anterior meningocele by a posterior Kraske incision from another patient, a woman thirty-eight years of age; she recovered after the operation. The third patient, a woman thirty-one years of age, died of chronic meningitis after four years' duration as a result of a spontaneous fistula between the anterior meningocele and the rectum. She had given a history of discharge of up to 1 pint (473 cc.) of spinal fluid daily from the rectum.

the clinic September 22, 1944. Her only previous illness had been an attack of influenza in 1918. Tonsillectomy had been performed at the age of fifteen years and ligation of the Fallopian tubes in 1926. Her mother had died at the age of fifty-four years of meningitis and her father had died of cancer of the stomach. One full sister and a half brother were living and well. She stated that bilateral Petit's hernia had been present since birth but had never caused her discomfort, even during her normal pregnancy and delivery twenty years earlier. However, about ten years before, the hernia on the right side had begun to enlarge and during the past two years it had enlarged rapidly. The first attack of abdominal pain had occurred one year prior to admission and had persisted for one hour. A second attack had occurred about one month prior to admission with an acute, severe pain in the left flank associated with abdominal distention but no vomiting. Her physician had manipulated the hernial mass and had been able to reduce it, after which the symptoms had subsided.

The patient exhibited no neurologic findings; she had good control over urethral and anal sphincters. She was 60½ inches (154 cm.) tall

and weighed 172 pounds (78.0 kg.). Her blood pressure was 108 mm. of mercury systolic and 76 diastolic, the pulse 104 and temperature 98.6°F. She was edentulous. A large pelvic mass measuring 12 by 12 cm., non-tender and movable, displaced the cervix anteriorly. This was thought to be ovarian in origin. The patient gave a history of menorrhagia the first two to three days of her period, which lasted about six days. There was mild leukorrhea. There was a huge apron-like Petit's hernia in the right lumbar region and a small hernia in Petit's triangle on the left side. One could palpate bowel and the right kidney in the contents of the hernial sac.

On September 28, 1944, while the patient was under nitrous oxide and ether anesthesia, the pelvic mass was explored through a secondary low midline incision with excision of the umbilicus. The cyst was ruptured in the course of removal and proved to be a meningocele, which was connected to the spinal canal through an opening 2.5 cm. in diameter in the sacrum. Since it was not possible to ligate the neck of the meningocele sac or approximate the edges of the defect, two pieces of oxidized gauze impregnated with thrombin were inserted into the spinal canal and two additional pieces were placed over the aperture of the opening. The retroperitoneal tissues were approximated as well as possible. A tubo-ovarian abscess was present on the left side and cystic oophoritis affected the right ovary. The pelvis was one mass of adhesions and the uterus was firmly fixed to the anterior abdominal wall. Total abdominal hysterectomy and bilateral salpingo-oophorectomy were performed with much difficulty. (Fig. 1.)

The pathologist reported the cyst to be a meningocele measuring 12 by 11 by 9 cm. Subinvolution of the uterus was graded 2 (on the basis of 1 to 4, in which 1 designates the mildest and 4 the most severe condition). The uterus contained a single fibromyoma 6 mm. in diameter. The endometrium was hypertrophic. Chronic cystic cervicitis and bilateral subacute and chronic salpingitis with perisalpingitis were present. A tubo-ovarian abscess, 6 cm. in diameter, involved the left tube and ovary. In the right ovary there was chronic cystic oophoritis.

Postoperatively, residual urine was present in the bladder for a few days; otherwise the patient's convalescence was uneventful. She was dismissed to her home on the thirty-third postoperative day, at which time the incision was well healed and the pelvic examination gave negative results. A postoperative pelvic roentgenogram (Fig. 2) revealed asymmetry of the pelvis with a right sacral defect and with sacralization of the fifth lumbar vertebra.

The patient returned to the clinic on May 8, 1945, for repair of the right Petit hernia. (Figs. 3, 4 and 5.) She now noticed sharp shooting abdominal pain when she climbed stairs and she had increased difficulty from constipation. No recurrence of the pelvic meningocele was detected by pelvic examination. Urinalysis showed a specific gravity of 1.015, acid reaction, albuminuria, grade 1, and 3 leukocytes per high power field. The concentration of hemoglobin was 10.5 Gm. per 100 cc. of blood. Erythrocytes numbered 5,450,000 and leukocytes 8,800 in each c.mm. of blood. The Kahn reaction was negative. A roentgenogram of the thorax showed slight dorsal scoliosis.

On May 12, 1945, after the gastrointestinal tract had been thoroughly emptied by means of cathartics and enemas and while the patient was under continuous spinal anesthesia, a large amount of skin and subcutaneous tissue overlying the hernial sac was excised. The sac was found to contain the greater part of the intestinal tract and the right kidney. There was an oval-shaped defect about 5 inches (13 cm.) in width in the region of Petit's triangle, which was the result of a congenital absence of the attachment of the transversus abdominis and internal oblique muscles to the transverse processes of the lumbar vertebrae and to the crest of the ilium. The sac was inverted without opening the peritoneal cavity and the defect was closed by a basket-weave type of repair, using seven strips of fascia lata, each about 8½ inches (22 cm.) in length, taken from the right thigh by the Masson fascia stripper. The fascia (Figs. 6 and 7) was anchored through drill holes into the crest of the ilium and by taking the fascia through the ligaments about the transverse processes of the third and fourth lumbar vertebrae. Five Gm. of sulfathiazole was placed in the incision and a split rubber tube drain was inserted down to the aponeurosis.

The patient made an uneventful convalescence and the incision healed by first intention. She was dismissed on the twenty-sixth postoperative day to return to her home. When she was examined at the clinic four and a half

months after the second operation, she was found by both rectal and vaginal examinations to be without evidence of recurrence of the pelvic meningocele and to have a very firm repair of the right Petit hernia. She will return to the clinic at a later date for repair of the left Petit hernia.

SUMMARY

We have reported data on a case in which there were two unusual lesions of congenital origin, bilateral Petit's hernia and anterior sacral meningocele, both of which proved amenable to surgical treatment. Although anterior sacral meningoceles are rare, they must be considered when dealing with retroperitoneal pelvic masses. These lesions are of particular importance to the surgeon, since he is faced with the possibility of fatal meningitis unless he recognizes the lesion and repairs it at the time of operation. Closure of the defect in the continuity of the spinal canal in this case was accomplished by use of oxidized gauze packs impregnated with thrombin. A large, incapacitating Petit hernia was repaired by a basket-weave method, using strips of fascia lata with anchorage to the iliac crest and transverse processes of the lumbar vertebrae.

Although a Petit hernia is unusual, the case reported is even more so, since the hernias were congenital and bilateral.

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TRAUMA TO THE ABDOMEN

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THE war and the increased speed in production and transportation have added to the number of injuries to the abdomen and its contents. These injuries call for an early and accurate diagnosis, and the institution of immediate treatment.

Abdominal injuries are classified as penetrating and non-penetrating.

PENETRATING TRAUMA

Penetration of the abdominal wall may be caused by bullets, bomb or shell fragments, knives or bayonets, flying splinters of wood, glass or other objects.

Penetrating injuries relieve the surgeon of the responsibility of deciding whether or not operation is indicated since all penetrating wounds must be explored, even though some do not enter the peritoneal cavity. The decision as to whether or not operation is indicated in cases seen after twenty-four hours will depend upon the physical findings.

Although the use of penicillin and the sulfa drugs have lessened the number of deaths in abdominal injuries, the mortality rate still remains high. Hamilton and Duncan[44] report an operative mortality of 48.9 per cent in 190 cases of gunshot wounds of the abdomen. Elkin and Ward[26] report an operative mortality of 46.4 per cent in 209 rifle and pistol wounds of the abdomen, and 55.5 per cent in twenty-nine cases of shotgun wounds of the abdomen. DiLorenzo[22] reports a mortality of 78 per cent in nine cases of gunshot wounds of the small bowel and 71 per cent in seven cases of gunshot wounds of the large bowel. Mulholland[66] reports a mortality of 51 per cent in seventy cases of penetrating abdominal wounds.

Gordon Taylor[40] points out that wounds penetrating the abdomen from one side to the other are more serious than those proceeding anteroposteriorly. In perforating wounds the line of the tract acts as a clue to the path of the missile and the structures likely to be involved. The straight line path does not hold when there is no wound of exit.[69] X-ray localization is helpful. Absence of an exit wound does not necessarily mean that the foreign body is lodged within the peritoneal cavity. It may be buried in the abdominal parietes, rectum, bladder, vertebral column or retroperitoneal space.

The greatest single cause of death in gunshot wounds is shock and hemorrhage with peritonitis less than half as frequent. There is a progressive increase in mortality from peritonitis as the level of the bowel perforation descends from the jejunum to the colon.

The entrance wound produced by a bullet is almost invariably smaller than the caliber of the bullet, while wounds of exit are larger. The wound of entry caused by a rifle bullet usually has a small more or less circular appearance.[98] Injuries caused by fragments are more disruptive and cause considerable laceration of the underlying muscle and irregular tears of the viscera. Fragments are usually irregular and may carry pieces of clothing into the abdomen.

It is important to ascertain the time interval between the injury and operation, as well as the direction of the force. The possibility of associated injuries to the back, loin and thorax must be carefully considered.

Stab wounds that penetrate the peritoneal cavity may not injure the viscera,

and Martin[56] failed to find visceral injury in thirty-one of the fifty-seven cases of stab wounds in his series. Exploratory laparotomy may reveal perforating wounds without visceral involvement.[10] It is impossible to make this diagnosis without visceral inspection.

Rippy[83] claims the mortality of stab wounds is not as high in civilian cases as the knife blade is not as long as the bayonet and therefore causes less intraperitoneal damage. The intraperitoneal damage will depend upon the length of the blade, the amount of force and the thickness of the abdominal wall. Bayonet wounds differ but little from stab wounds seen in civilian life. Exploration is indicated when there exists any question of doubt as to the depth of the wound and one must not wait for clinical signs to establish the diagnosis. Greater attention is given to the suturing of the injured viscera and less to the débridement of the superficial wound.

The peritoneum has remarkable powers of combating infection. This power is enhanced by the removal of sources of infection and by the closure of all perforations in the hollow viscera. It is useless to attempt sterilization of the abdominal cavity by irrigation or similar means.

Willis[103] states that multiple small visceral wounds produced by buckshot at close range defy surgical repair, as a rule, and that patients who have such wounds may recover under conservative treatment.

Lovelace[54] warns against transportation of suspected intestinal injuries at comparatively high altitudes, as the gas in the intestine expands and may be forced through small perforations or the traumatized intestinal wall.

NON-PENETRATING TRAUMA

Intra-abdominal injuries may be present in spite of an intact overlying skin.[5] Non-penetrating injuries may be sustained under confusing conditions and the history may be vague and indefinite.[87] The site of internal injury may be suspected by bruising of the overlying abdominal wall.

The causative factors of violence may be generalized, such as run-over accidents, falls from a height, compressions, blast injuries and tears of a viscus by fractured bone spicules; or localized, such as a punch, a kick or thrust by a dull implement.

Local or circumscribed blows commonly injure the intestines, mesentery and bladder, while diffuse blows usually injure the solid and fixed organs. Fatheree[29] in his review, states that 60 to 78 per cent of intra-abdominal injuries by blunt force affect the solid organs. This is due to the firmer fixation of these structures as compared to the mobility of the hollow viscera. A relaxed and flabby abdominal wall requires less force to cause injury to the intraperitoneal organs than a muscular and firm abdominal wall. The effect of a blow upon the viscera will depend upon whether or not the hollow viscus is distended or empty. A distended hollow viscus and an enlarged pathological solid viscus are more prone to injury.

A sudden increase in the intra-abdominal pressure by a crushing injury may compress the fluid or gas in a single loop of intestine[43] and wedge the viscus between the instrument of force and the spinal column. The introduction of gas or solid objects into the rectum may cause intra-abdominal damage. Penetration of a viscus by spicules of bone is not frequent and is seen in fractures, particularly of the pelvis. Blast injuries may cause severe intra-abdominal damage without any evidence in the abdominal wall.

Immersion blast may result in immediate death or present the picture of an acute condition of the abdomen. Severe visceral damage or retroperitoneal hemorrhage may be produced by blast without any external evidence of injury.[41] The general picture may be misleading and the decision as to operative intervention difficult. Late perforation may occur as a result of gross bruising and damage to the blood supply. Pinnock and Wood[74] stress the extreme

difficulty which may arise in differentiating between upper abdominal rigidity due to peritonitis and that secondary to a thoracic lesion. The microscopic examination[25] reveals fragmentation and perforation of all the intestinal layers. The apposing edges are infiltrated with leucocytes, lymphocytes and plasma cells, and show considerable superficial necrosis. Comparatively little regenerative cell growth, fibroblastic activity or evidence of repair are noted around the perforation.

Stein,[92] Webster, Ross and Alford[102] state that the prevention of this entity can be enforced by instructing individuals who anticipate under-water detonations, to float on their backs or elevate the buttocks above the water level.

SHOCK AND HEMORRHAGE

The differentiation between hemorrhage and traumatic shock is sometimes difficult. The clinical picture may add little, yet the laboratory findings are of great value. Shock and hemorrhage are the most common immediate causes of death. Hemorrhage must be controlled and shock prevented or overcome. Hemorrhage is tolerated poorly by the very young, the aged and the diseased. Women withstand hemorrhage better than men.

The symptoms and signs of hemorrhage are restlessness, thirst, air hunger, palor, cold, moist skin, widely dilated pupils, subnormal temperature, nausea, syncope, vertigo, disturbance. in vision and a rapid thready pulse. There is a fall in blood pressure. As a rule the blood count shows a loss of red cells and an increase in white cells. In abdominal injuries hemorrhage may be delayed and a secondary hemorrhage is not altogether uncommon. A secondary hemorrhage may occur two or three weeks after the original injury.

In traumatic shock there is a drop in blood pressure, a rapid thready pulse, a diminution in the blood volume, an increase in the red blood cells and percentage hemoglobin, the temperature is subnormal, the skin is cold and moist, there is a grayish and slightly cyanotic appearance and the respirations are superficial and often of the sighing type. Hematocrit readings, the determination of the specific gravity of the blood and the serum protein will indicate the amount of blood or blood plasma loss and the necessary treatment. An early leucocyte count is of little value. Wangenstein[99] found that the white blood cell count is usually normal in cases of perforation of a hollow viscus and slightly elevated in cases of hemorrhage. Scudder[88] claims a constant rise in the plasma potassium content in shock, whether it is due to trauma, toxine, hemorrhage or loss of fluids.

Shock and hemorrhage therapy precedes any surgical intervention unless there is active bleeding. A continuous fast pulse with a falling blood pressure, despite shock treatment, suggests bleeding and demands operative intervention. Hemorrhage must be controlled by ligating any bleeding points and the shock of hemorrhage by the intravenous administration of blood. Shock is treated by covering the exposed viscera with warm saline pads to protect the belly wall. The patient should be kept warm. Morphine is indicated in all cases excepting those of suspected head injury. The use of renal cortical extract has proven of value and the administration of 5 to 10 cc. of eschatin may have a very decided beneficial effect. Shock position, that is, the foot of the bed elevated, although frowned upon by some, has been found of value by us. The inhalation of oxygen by masque, nasal tube or tent has been proven efficacious. Plasma intravenously has been most effective. The intravenous administration of 5 per cent glucose in a normal salt solution may be carried out until plasma is obtained.

CLINICAL PICTURE

Abdominal trauma may be classified into three groups:[35] (1) Severe multiple injuries which are usually rapidly fatal regardless of treatment; (2) cases that require immediate operation; and (3) cases in which

the diagnosis is doubtful and the type of treatment is undecided.[55]

The decision as to operation will depend upon the general appearance of the patient, the pulse, blood pressure, abdominal signs and the laboratory findings. As a rule there is a history of trauma[46] followed by abdominal pain. Localized early pain, spreading and becoming generalized, suggests leakage. A ruptured hollow viscus causes immediate peritoneal irritation, with a resultant pale, drawn face and an alert and apprehensive expression. In addition, there is pain aggravated by motion, vomiting, rapid costal breathing, abdominal tenderness, rigidity and tympanites. These findings are finally supplemented by listlessness and signs of toxemia. Severe persistent pain, continuous or intermittent, localized or generalized, associated with vomiting or retching and diffuse tenderness and muscle spasm, with or without signs of hemorrhage, demands immediate exploratory laparotomy.

Examination. A general physical examination will detect wounds entering the abdomen via the buttocks, thighs, perineum or thorax.

Inspection. Inspection will reveal gunshot and stab wounds as well as contused areas resulting from blunt non-penetrating trauma. A stab wound may extend down to the peritoneum but not into it. Herniation of omentum is indicative of peritoneal penetration. The exposed viscera may vary from a protrusion of one or two segments of intestine to a complete evisceration. A fullness may be visible in the abdominal wall, in the abdominal cavity or in the retroperitoneal tissues. An intraperitoneal tumefaction goes through a wider range of respiratory excursion than a retroperitoneal enlargement. The absence of abdominal wall excursion indicates peritoneal irritation and perforation. Hemorrhage from a solid organ may result in a localized swelling, whereas hemorrhage or leakage from a hollow viscus or mesentery will result in a diffuse swelling.

Palpation. Rigidity of the abdominal muscles is a measure of the degree to which the parietal peritoneum has been irritated.[61] Thoracic, vertebral and abdominal wall injuries may result in abdominal pain, rigidity and distention. The rigidity of the purely thoracic wound is strictly unilateral, whereas the rigidity in abdominal wounds is bilateral.[9,70]

Percussion. An area of unusual dullness following an abdominal injury suggests a collection of blood or intestinal contents in the peritoneal cavity. It requires about 6 quarts of fluid to illicit shifting dullness, therefore, the demonstration of free blood in the peritoneal cavity is of doubtful diagnostic value.

Roentgen Studies. Roentgenograms are of diagnostic aid in revealing gas within the peritoneal cavity following rupture of a hollow viscus[80] and determining the location of foreign bodies.[37] Gas when present in the peritoneal cavity is certain evidence of hollow visceral perforation. Unfortunately, the absence of pneumoperitoneum does not entirely exclude rupture of a hollow viscus.[27,28,31] Free air under the diaphragm is more commonly present in perforations of the upper small bowel. Perforations especially at the ileocecal valve may be temporarily sealed off and thereby prevent the escape of gas. The condition of the patient will determine whether roentgenograms are taken in the erect or in the lateral decubitus position.[8,15]

Preoperative Care. It is inadvisable to rub the abdomen, as vigorous rubbing may stimulate peristalsis or actually compress the gas filled intestines and increase the escape of intestinal contents. Sedation, antitetanic and antigas sera, should always be administered.

Anesthesia. Anesthesia in abdominal trauma is a controversial subject. The ideal anesthesia will combine high oxygenation, complete abdominal relaxation, maintenance of the blood pressure and early return to consciousness following the discontinuation of the anesthetic.

Peterson, of our Department, believes that cyclopropane alone or in conjunction with small amounts of ether comes closest propane has been found to be an extremely valuable drug in obtaining complete relaxation comparable to that of spinal anes-

LINEA SEMICIRCULARIS

RECTUS ABDOMINIS

INF EPIGASTRIC ARTERIES AND VEINS

TRANSVERSUS

INTERFOVEOLAR LIG.

SPERMATIC CORD

INGUINAL APONEUROTIC FALX
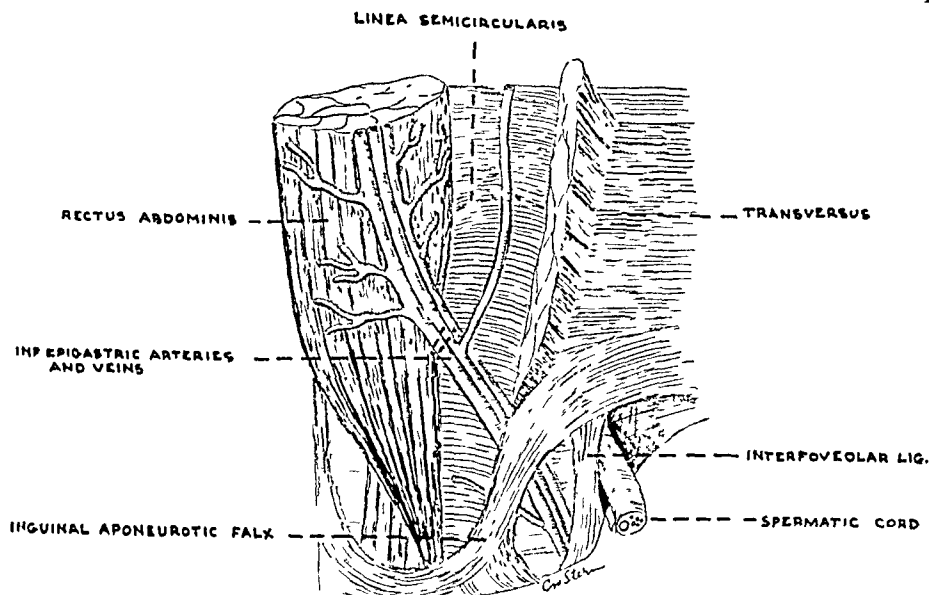
FIG. 1. Anatomy of rectus muscle and epigastric vessels.

M. OBLIQUUS EXTERNUS ABDOMINIS
M. OBLIQUUS INTERNUS ABDOMINIS
M. TRANSVERSUS ABDOMINIS

PERITONEUM
FASC TRANSVERSALIS
LINEA SEMILUNARIS
M. RECTUS ABDOMINIS

LINEA ALBA

ANTERIOR LAYER OF RECTUS SHEATH
POSTERIOR LAYER OF RECTUS SHEATH
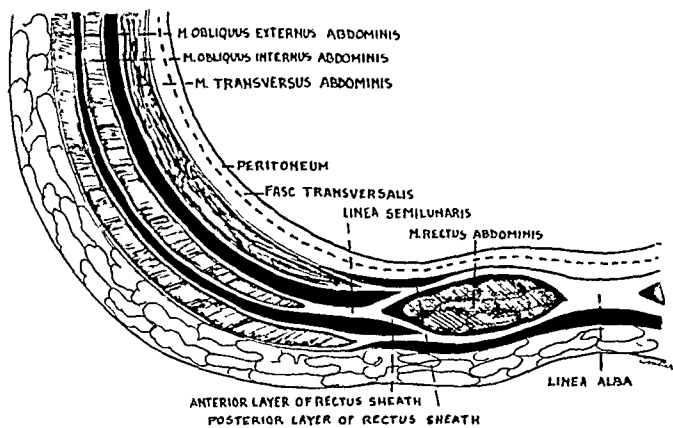
FIG. 2. Cross section of abdominal wall.

to fulfilling these requisites, Induction is rapid with absence of minimal excitement. High oxygenation is maintained because of the high potency of the agent. The recovery period in which premedication is not excessively heavy is rapid, within a period of five to ten minutes. Circulation is not depressed but most frequently improved. Relaxation may or may not be readily obtained with cyclopropane, depending upon the physical status of the patient and the skill of the anesthetist. Curare combined with cyclo-

thesia. Endotracheal intubation is indicated when there is difficulty in maintaining an airway and there is danger of aspirating gastric or intestinal contents.

Strode[95] and many others[53,82] prefer ether as the easiest and safest anesthesia. Sodium penthothal is preferred by Rose and Hulkert.[12] Spinal anesthesia is preferred by Storck[94] and Bove,[12] when there are no signs of impending shock.[6,66] Local anesthesia is rarely used[84] but may be utilized for superficial wounds not penetrating the peritoneum.

PROCEDURE

Incision. The incision should be ample, through all the layers in the same plane and

and the transverse or oblique lateral incision for access to the lateral parts.[33] The accidental wounds of entrance and exit
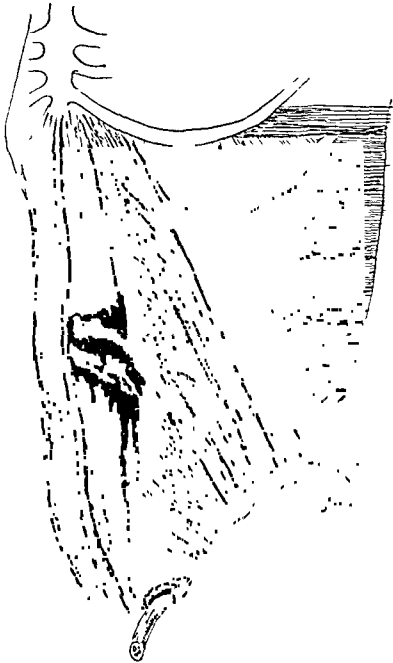
FIG. 3. Rupture of rectus muscle and epigastric vessels.

allow adequate access to the peritoneal cavity.[93] The incisions may be varied to meet the individual case. The commonly
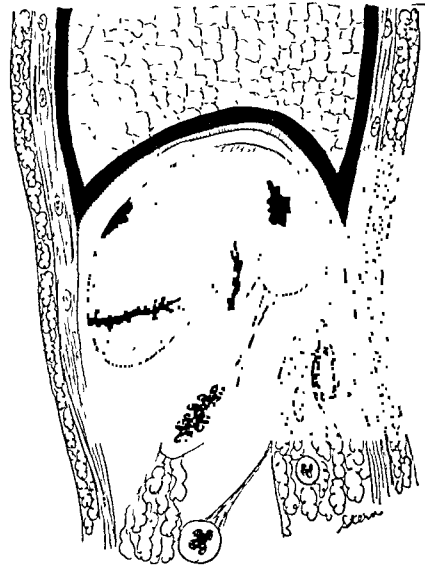
FIG. 4. Lacerations of liver.

are thoroughly cleansed and then excised.[97] In large wounds of the abdomen it may be advisable to incise through the penetrating wounds. In the smaller gunshot or stab penetrations it may be more advantageous to avoid the original wound and utilize a separate incision.
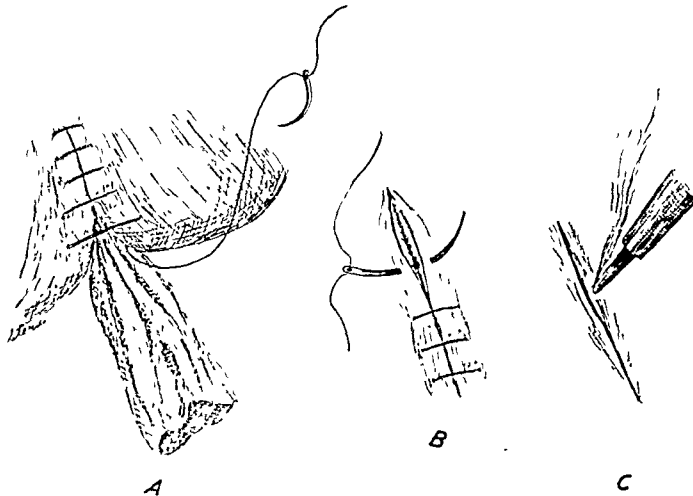
FIG. 5. A, packing of liver; B, capsular suture; C, cautery.

acceptedones are the vertical paramedian,[38] or median incision for approach to the central part of the abdomen or the pelvis,

Operation. Upon opening the peritoneum one notes the presence of intestinal contents, blood or gas. Hemorrhage is

controlled by finding the bleeding vessels, clamping and ligating them. Avoid mass ligation. Massive hemorrhage may be
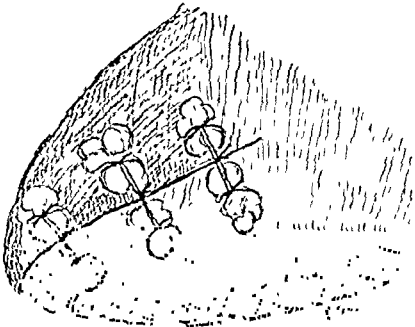
FIG. 6. Omental graft reinforcing suture line.

controlled by digital pressure or pressure packing.

Foreign bodies, particles of clothing and detached particles of visceral content are quickly and gently removed. The use of moist sponges is advisable.
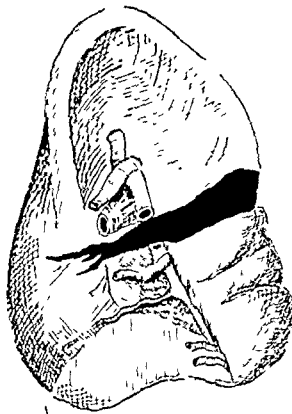
compression, the exposure of a single region of the abdomen may be sufficient, whereas in gunshot wounds exploration of the entire abdominal cavity is indicated.

The large intestine is explored in sequence, beginning at the cecum and terminating at the rectum. The small intestine is then inspected, working upwards from the ileocecal valve to the duodenojejunal junction. Warm moist packs are used to handle the intestines and a Babcock marker will avoid unnecessary handling of the intestines.

Small longitudinal perforations are closed transversely by means of a continuous suture of fine chromic catgut which includes all the layers and a Lembert suture of interrupted fine silk sutures.

Multiple perforations in close proximity often require resection of the intestine and end-to-end anastomosis.

FIG. 7. Splenic tears.

Irrigation with saline under pressure[55] has been discarded since the advent of sulfa and penicillin therapy,[26,66] but if it is necessary to cleanse the abdomen it is used. A systemic exploration is then carried out, starting at a fixed point. The viscera are examined for perforation and tears. Bleeding points are sought and the root of the mesentery inspected. Evisceration of more than one loop of bowel at a time during inspection is to be avoided if possible, because of the chilling effect and the drag on the mesentery.

In non-penetrating injuries by blows or

Wound Closure. Upon completion of the exploration and repair of the damaged tissues and peritoneal cavity is again aspirated,[26] cleansed and dried. Four to 6 Gm. of sulfanilamide crystals are dusted into the peritoneal cavity.[34,47,57,64,65,104] The peritoneum is closed with either a running double strand of chromic catgut[3] or interrupted quilting cotton sutures.[11,106] The traumatized surface of the peritoneum is everted, thereby avoiding adhesions. Drainage[77] is always a matter for the judgment of the operating surgeon. The consensus of opinion is against drainage of the peritoneal

cavity,[63] yet a few favor drainage, as a slipped suture will permit leakage to the surface instead of bursting into the perito-

The incidence of wound dehiscence is particularly high after laparotomy for wounds of the liver, stomach and upper
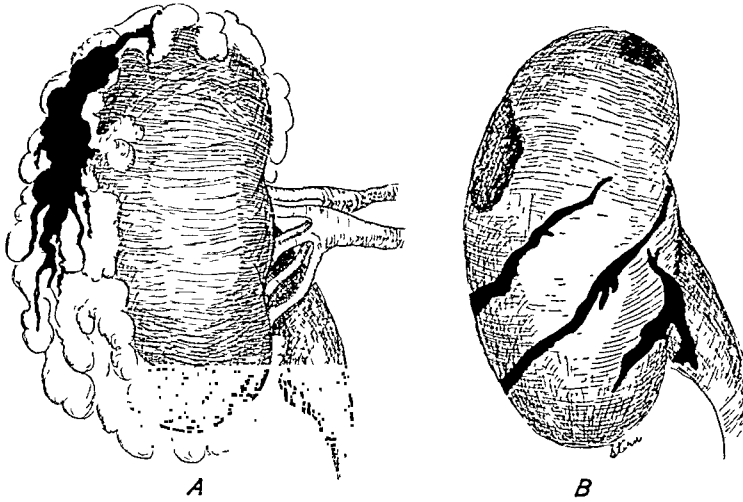
FIG. 8. A, hemorrhage in perirenal fat; B, kidney lacerations and contusions.
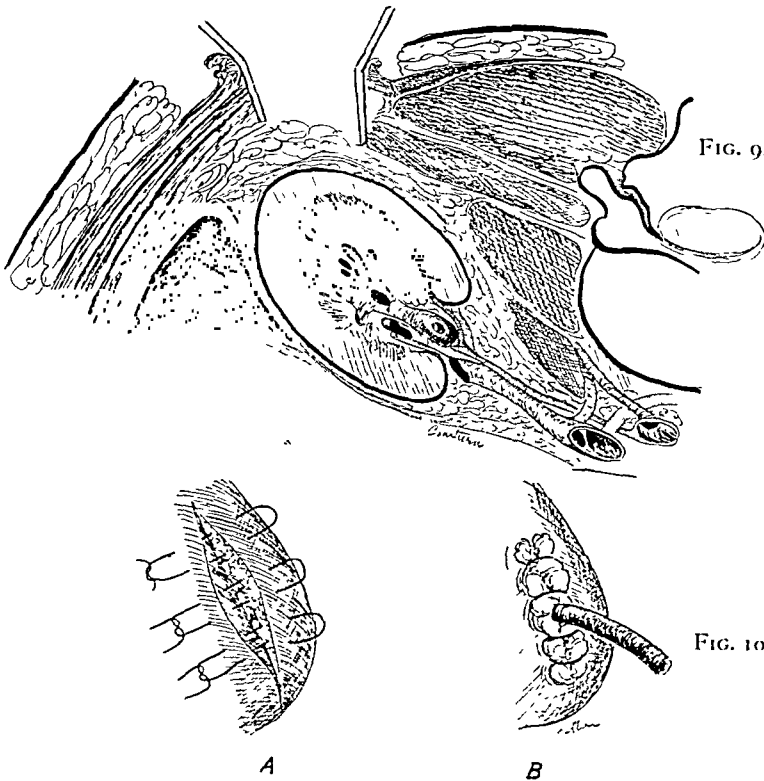
FIG. 9. Retroperitoneal approach to kidney.
FIG. 10. A, mattress suture; B, fat graft and drain.

neal cavity.[96] The absolute indications for drainage are the presence of bile in the abdomen and in the pancreatic wounds.

bowel. It is therefore suggested that through-and-through sutures of No. 28 stainless steel wire are inserted about

½ inch apart.[37,48,68,75] The muscles are approximated with interrupted chromic catgut sutures loosely tied and the skin is

8 cm. thick. (Fig. 2.) There is, of course, a wide range of variations according to body length, muscular strength and age.
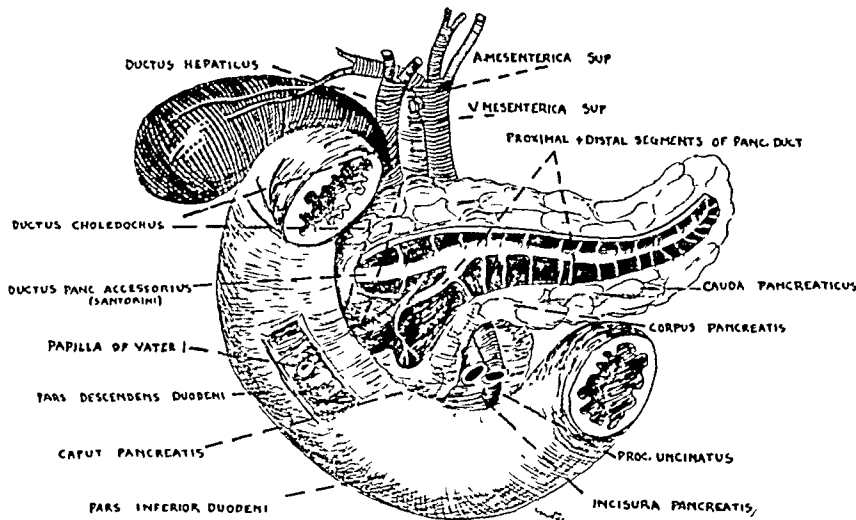
FIG. 11. Anatomy of pancreas.

closed with interrupted silk sutures loosely tied. The through-and-through sutures are then tied.

ABDOMINAL WALL

Injuries to the abdominal parietes may vary from mild contusions with subcuta-

FIG. 12. Post-traumatic pancreatic cyst.

neous hemorrhage to a complete tear of the rectus muscle and the underlying epigastric vessels. (Fig. 1.)

The entire muscular mass of the rectus[19] in the adult is 35 cm. long, 7 cm. wide and

Injuries may be caused by: (1) Direct trauma:[36] penetrating or non-prenetrating —as direct blows or stab and gunshot wounds, (2) indirect trauma: following violent effort, usually in young healthy adults.

It is frequently difficult to differentiate between hematoma of the abdominal wall, intraperitoneal bleeding and retroperitoneal hematoma.[72]

Contusion of the abdominal wall may result in sympathetic nerve stimulation with resultant pallor, anxious expression, nausea, vomiting and signs of shock. Peristalsis may be momentarily diminished. A simple contusion of the abdominal wall may be more painful than a visceral lesion before peritonitis sets in. When the parietal wall has been injured, localized tenderness and spasm will remain constant. Increase of intra-abdominal pressure will produce a protrusion of the abdominal mass when a hematoma of the abdominal wall is present.[72]

Deep rigidity must not be confused with painful spasm, limited to the abdominal wall as a result of trauma.[16] Progressive board-like rigidity indicates an intra-abdominal pathological condition.

Cullen[18] points out that when blood lies between the rectus muscle and the peritoneum the symptoms are usually those of an

from a slight distress in the right hypochondrium to profound shock. Peritoneal irritation due to bile and blood may refer
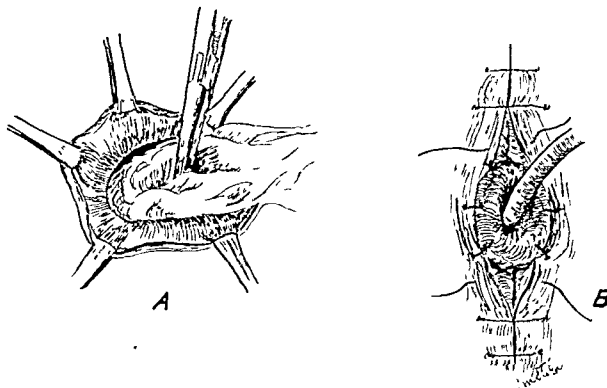
FIG. 13. A, opening and emptying of cyst; B, marsupialization of cyst.

acute intra-abdominal lesion. Hemorrhage is due to the tearing of the muscle and the deep epigastric vessels. (Fig. 3.) The hemorrhage usually occurs below the umbilicus and is nearly always limited to one side. The free blood lies directly against the peritoneum producing an irritation causing severe pain and suggesting an intra-abdominal lesion. In those cases in which the rectus muscle ruptures anteriorly, blood escapes into the fat with resultant ecchymosis of the skin. Treatment consists of incision of the rectus sheath, evacuating the hematoma and ligating the bleeding vessels. A few loosely tied interrupted muscle sutures may be used for coaptation purposes. Extensive tangential wounds may require débridement and closure with steel wire or heavy silk.

LIVER

The large size, fixation, friability and slight elasticity of the liver predisposes it to extensive fissuring or rupture with fragmentation. (Fig. 4.) Irregular tears may extend from the free margin into the liver substance. Coexisting injuries to the gallbladder, cystic and common ducts may exist.

Clinical Features. These will depend upon the extent of the parenchymal and vascular damage. The picture may vary

the pain to the right shoulder and right scapular region. Coexisting thoracic injuries must be excluded. X-ray studies may reveal
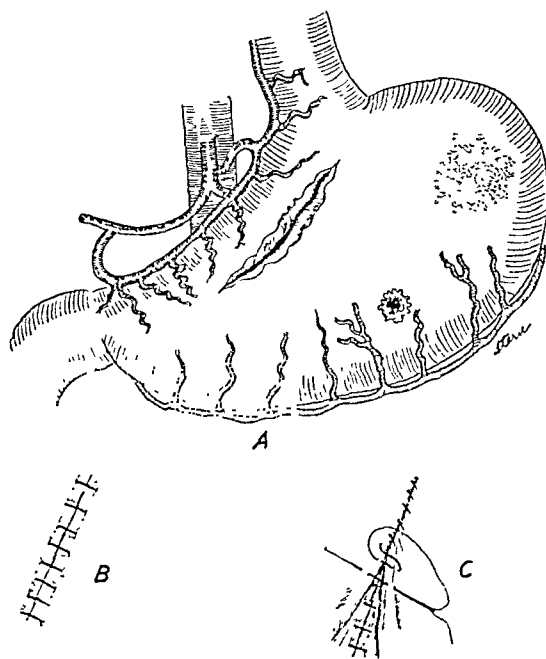
FIG. 14. A, lacerations of stomach; B, first row of sutures; C, second row of sutures.

elevation and immobilization of the right half of the diaphragm.

Non-penetrating Trauma. Crushing or falling injuries may result in (1) rupture of the capsule and liver parenchyma, (2) subcapsular rupture, and (3) central rupture.

Penetrating Trauma. This may produce any degree of the above plus clean cut, ragged, or fragmented wounds that range

Liver bleeding may be temporarily controlled by digital compression of the hepatic artery and portal vein at the foramen of
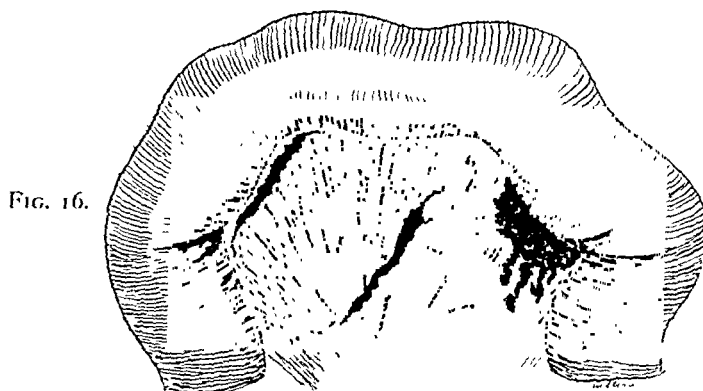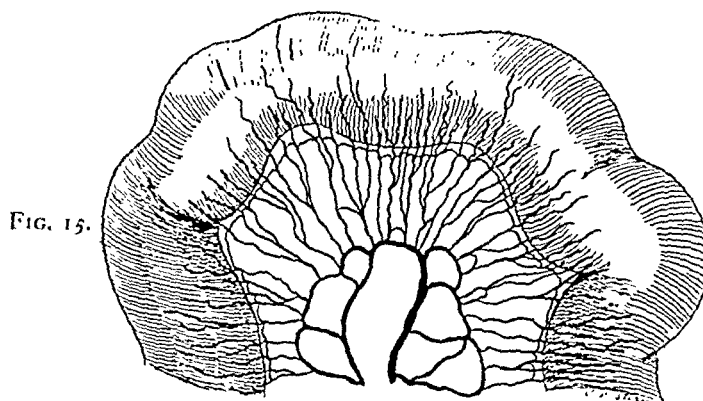
FIG. 15.

FIG. 16.

FIG. 15. Mesenteric branches to small intestine.
FIG. 16. Mesenteric tears.

from a simple penetrating wound to the separation and shattering of an entire lobe.

Treatment. Treatment should be (1) conservative, when it is certain that other organs have not been involved, and provided there are no signs of increasing hemorrhage; (2) exploratory, when there are signs of increasing hemorrhage, extensive damage, retention of a large missile and for coexisting injuries to the hollow viscera. During the exploration for suspected liver injuries, the posterior and inferior surfaces of the liver require careful inspection. Detached or devitalized liver fragments must be excised.

Moderate bleeding may be controlled by the use of cautery (Fig. 5) or the application of topical thrombin and pressure.

Winslow. More extensive bleeding may require packing (Fig. 5) or sutures which are loosely tied.

In extensive injuries of the liver it is advisable to cover the suture line with omentum or muscle and thereby prevent the suture material from cutting into the liver substance. (Fig. 6.) The packing is removed from the fifth to the eighth day, as too early removal may start bleeding. Whole blood transfusion is administered at the time of operation.

Gallbladder. Small tears near the fundus may require cholecystostomy. Large tears, or crushing injuries demand cholecystectomy.

Common Duct. A completely severed common duct is uncommon. It may be

repaired over a T tube or by ligation of both ends of the duct and anastomosis of the gallbladder to the duodenum or stomach.

Clinical Features. Hemorrhage is the main clinical feature associated with pain, tenderness, rigidity and absence of respira-
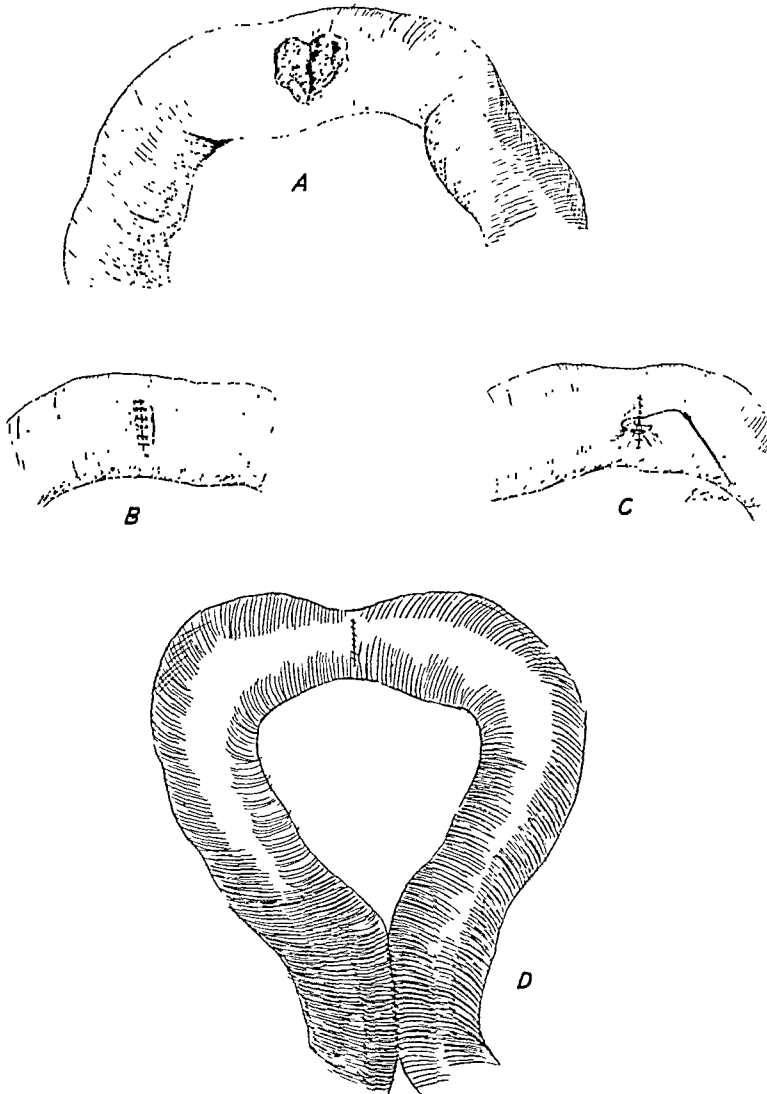
FIG. 17. A, lacerations of small intestine; B, first row of sutures; C, second row of sutures; D, lateral anastomosis.

SPLEEN

Splenic injuries are commonly caused by crushing trauma, falls, blows, fractured ribs and penetrating wounds. (Fig. 7.) The spleen is mobile, lacks elastic tissue and is fairly well protected by the thoracic cage. There may be coexisting injuries to the stomach, kidney, splenic flexure and jejunum. The lesions may vary from small single fissures to extensive lacerations with tearing of the linorenal ligament or pedicle.

tory motion over the left upper quadrant. Tenderness may be present over the supraclavicular fossa between the insertion of the sternomastoid and of that of the scalenius anterior muscles. Pain in the left shoulder area or over the left scapula may be present. Roentgenographic studies may reveal an immobile or an elevated left diaphragm. There is an increase in the area of splenic dullness, and gastric tympany may be obliterated.

There are two clinical syndromes: (1) Immediate hemorrhage with clinical manifestations of shock and hemorrhage, and and Prigot's[107] review of 3,000 autopsies showed no evidence of healed injuries.

The approach to the spleen is through a
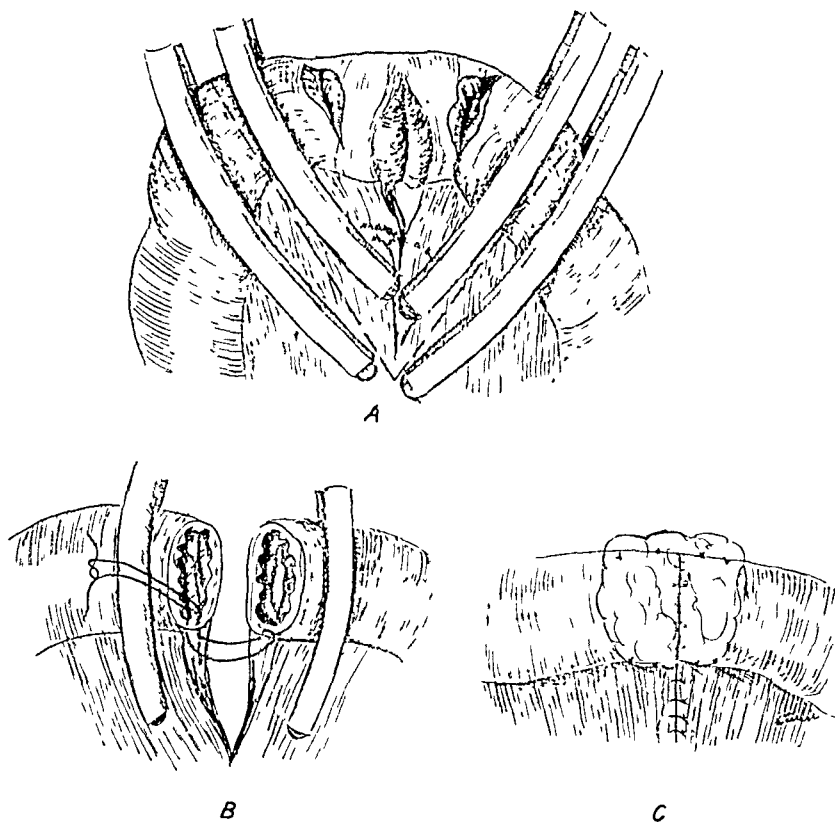
FIG. 18. A, resection; B, repair (end-to-end); C, omental graft.

(2) delayed hemorrhage with a latent period varying from forty-eight hours to several weeks.[21,30,91,109]

McIndoe[62] includes those cases in which the primary rupture is followed by complete or almost complete hemostasis for a latent period of more than forty-eight hours and then terminated by a delayed hemorrhage of dramatic onset and fulminating character. The pathological condition may manifest itself as capsular, subcapsular and parenchymal hematomas, or rupture of the hilar vessels.[85] Large hematomas may be the precursor of delayed hemorrhage. Waugh and Prior[101] emphasize the frequent association of rib fractures in delayed splenic hemorrhage.

Treatment. Suturing is not attempted as the spleen does not heal. McCarney[60] reviewed 25,000 autopsies and found no instance of healed splenic injuries. Wright

left paramedian incision which may require a horizontal extension. Blood clots are removed to allow visualization of the splenic pedicle. The splenic artery and vein are clamped under direct vision. Great care must be taken not to damage the pancreas or the stomach. The gastrosplenic and phrenicocolic ligaments are divided and the spleen is then removed.

KIDNEY

The kidney is a vascular organ covered by a firm capsule and perirenal fat. It is situated in the retroperitoneal space and protected by the overlying fascia, musculature and lower ribs. (Fig. 8.)

Injuries may be caused by: (1) Non-penetrating trauma; falls, blows and crushing injuries; (2) penetrating trauma; gunshot and stab wounds. Injuries may involve: (1) The hilum and large vessels. The renal

arteries are terminal and may result in necrosis of the kidney with resultant infection; (2) the pelvis, with leakage of urine into the retroperitoneal tissues or peritoneal cavity; (3) the parenchyma, with perforation, extensive laceration or bisection of the kidney; and (4) the perirenal tissues with hemorrhage and subsequent infection.

Clinical Features. The coexisting intra-abdominal trauma may mask the symptomatology. Hematuria is fairly constant, unless there is a severed ureter or urinary blockage by blood or renal tissue. Pain in the loin or costovertebral angle may be dull, lancinating or colicky in character. Renal shock may result in anuria. Renal or perirenal bleeding may produce a visual or palpable hematoma. There may be localized tenderness and rigidity in the lumbar region. Reflex peritoneal irritation may be manifested by adynamic ileus and abdominal rigidity.

X-ray studies may demonstrate a foreign body and evidence of renal injury, such as change in the size and contour of the kidney and absence of the psoas muscle outline. Intravenous urographic study may be helpful, but retrograde pyelographic study is dangerous,[99] unless one is prepared to operate immediately.[14] The capsule of the kidney is so firm that it will control hemorrhage unless the tear in the kidney is extreme. Immediate operation in kidney lesions is not usually indicated.

Treatment. Treatment may be (1) conservative in non-penetrating or penetrating injuries without signs of hemorrhage. Hourly red cell counts, hemoglobin, plasma volume, urine analysis, and blood pressure readings are charted. (2) *Operative:* Immediate operation is indicated for severe hemorrhage or marked peritoneal injury. The kidney is approached through a curved loin incision. (Fig. 9.)

When severe intra-abdominal injury is coexisting, laparotomy and exposure of the kidney through the posterior peritoneum may become necessary. The following procedures may be performed:

1. *Suturing of localized wounds:* The cortex is repaired by interrupted sutures, perirenal fat being utilized to reinforce the
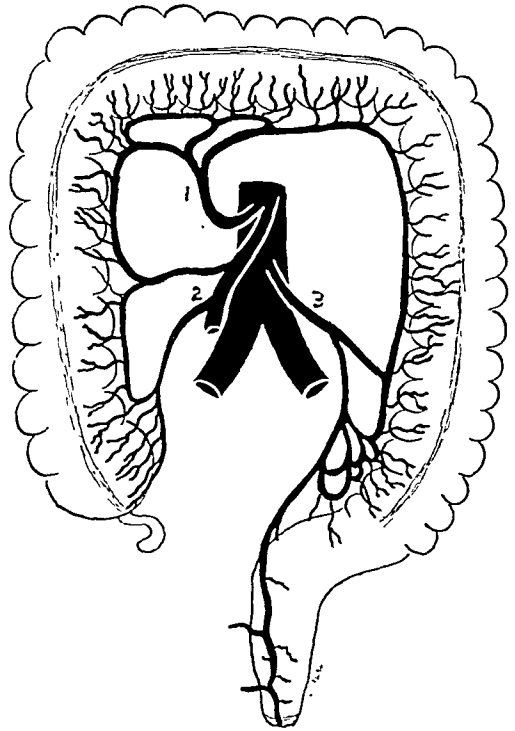
Fig. 19. Blood supply to large intestine: 1, middle colic artery; 2, right colic artery; 3, inferior mesenteric artery.

suture line. (Fig. 10.) Mattress sutures must be loosely tied as they may result in a wide area of necrosis. When the kidney pelvis has been opened, drainage is maintained for about forty-eight hours.

2. *Partial nephrectomy* is indicated when the trauma is limited to a branch of the renal artery, or for polar injuries involving a small section of the kidney. Nephrostomy drainage is maintained until a clear urine is obtained.

3. *Nephrectomy* is indicated for tears of the vessels of the pedicle, or for extensive fragmentation of the kidney. When the patient's condition is grave, clamps may be left on the renal pedicle for several days and no attempt made to ligate the bleeding vessels.

PANCREAS

The pancreas is a fixed glandular organ situated in the lesser sac and rests on the

vertebral column. (Fig. 11.) It is well protected. It may be injured by blows in the epigastric region or by crushing it
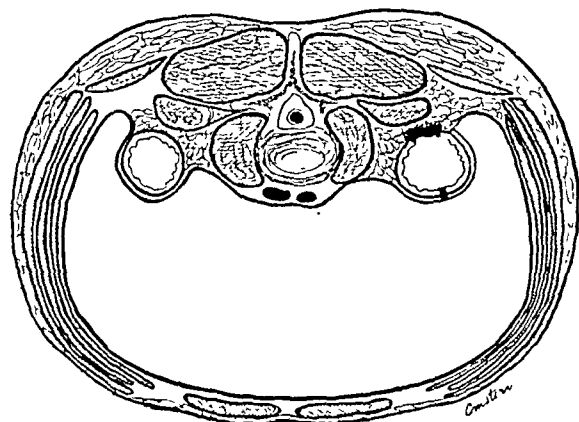
FIG. 20. Cross section anatomy of intra- and retroperitoneal lacerations of colon.

against the vertebral column. The lesions vary from tears in the head, body or tail, with or without involvement of the ducts, or a simple contusion. Hemorrhage into the substance or into the lesser bursa may result in cyst formation. (Fig. 12.)

Clinical Features. Severe shock is usually present. There may be excruciating pain in the epigastrium with formation of a mass above the umbilicus. A collection of ascitic fluid may be present. When objective evidence of intra-abdominal injury is absent or uncertain, an increase in the serum amylase level occasionally may be the earliest sign of injury to the pancreas.[67] The increase in the blood serum amylase following trauma to the pancreas probably results from the emptying of the injured acini and ducts into the interstitial spaces or into the peritoneal cavity or both.

Treatment. The pancreas is exposed by incising the lesser or gastro-colic omenta. The devitalized portion of the pancreas is removed and the divided ducts are ligated if not reparable. Lacerations of the pancreas are repaired with non-absorbable sutures. Soft rubber tissue drains are placed down into the injured pancreas. Cysts of the pancreas[42] are incised, emptied and marsupialized. (Fig. 13.)

STOMACH

The large size and the exposed position of the stomach renders it vulnerable to trauma. (Fig. 14.) The pathological condition may be limited to one or both walls, or include the curvatures with their highly vascular anastomoses. High explosive shells create jagged lacerations, whereas bullets result in small lacerations.

Clinical Features. Hematemesis and persistent retching are fairly constant findings. There is evidence of peritoneal irritation with either localized or diffuse pain, tenderness and associated rigidity. X-ray studies will reveal free gas in the peritoneal cavity.

Treatment. A left paramedian incision is utilized. Wounds of the cardia are difficult to expose and may require a transpleural approach supplemented by a phrenic nerve crush.

The wound edges are freshened, if necessary. Exploration of the posterior wall must not be omitted.[50] Insufficient exposure through the gastrocolic or gastrohepatic omenta, may call for enlargement of the anterior perforation to allow transgastric exposure and repair.[79] Wangenstein[99] has demonstrated in experimental animals that wounds up to 1 cm. in length are tolerated without mortality. The wounds are closed in layers with chromic catgut and the last layer with Lembert sutures. Gastroenterostomy is avoided but may be necessary in wounds of the pyloroduodenal junction.

SMALL INTESTINE AND MESENTERY

Injuries to the small intestine are fairly common and the resultant perforations are usually multiple due to the close proximity of the intestinal coils. (Fig. 15.) Frequent sites of rupture are the ileocecal junction and the duodenojejunal junction.[31] Mild trauma may rupture the intestine without any clinical signs for several hours. Signs of peritoneal irritation may not make their appearance until active peristalsis is reactivated, thereby resulting in leakage from the perforation into the peritoneal cavity.

Bullets usually produce small punctate wounds with eversion of the mucosa. (Fig. 17A.)

Wounds of the mesentery usually occur as complications of small intestinal wounds. Wounds of the mesentery may occur at the intestinomesenteric junction, in the midsection, or at its posterior attachment. (Fig. 16.) Extensive wounds at the intestinomesenteric border usually require resection of a triangular segment of small intestine.

Treatment. The most important principle is the finding and closure of all perforations. It is important to inspect the intestine adjacent to the perforation in order to decide whether to perform individual closures or resect a segment. The mesenteries are routinely examined when a large quantity of blood is present in the peritoneal cavity. A hematoma at the junction of the mesentery and intestine must be carefully examined for perforations, the hematoma evacuated, bleeding points grasped and tied.

1. Enterorrhapy is always preferable to resection. The intestine is closed in the transverse axis by means of a self-inverting Connell suture supplemented by a Lembert suture. (Fig. 17B.) A lateral anastomoses can be performed for narrowing of the intestinal lumen. (Fig. 17.)

2. Resection is indicated for destruction of large segments, for multiple large perforations within a short distance and for mesenteric injuries compromising the blood supply to the intestine. End-to-end resection with a double row of sutures is preferable since it can be readily and rapidly performed. (Fig. 18.) With ligation of the vessels of the mesentery there is the risk that an adjacent loop of intestine has been deprived of its essential blood supply and resection may be necessary beyond this doubtful segment. In cases of doubt, a small incision can be made in this questionable segment, free bleeding indicating a satisfactory blood supply.

Wise and Romansky[105] stated that in World War I there was no successful triple resection of intestines recorded. As much as one-quarter to one-half of the small intestine can be removed with safety.
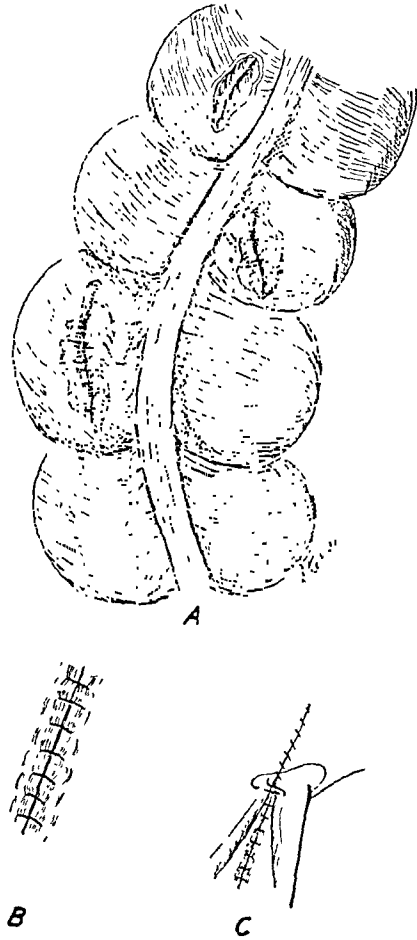
FIG. 21. A, lacerations of large intestine; B, first row of sutures; C, second row of sutures.

3. Exteriorization of the injured segment and double barrel enterostomy may be expedient in grave cases. Venostasis of the mesentery[20] is closely associated with ileus, therefore, tight bandaging of the abdomen is to be avoided in these cases.

DUODENUM

Injuries to the duodenum[32] are usually associated with other injuries. The duodenum because of its fixed position is vulnerable to crushing injuries which compress it against the unyielding vertebral column. X-ray studies of the duodenum

may reveal gas about the retroperitoneal tissues. Gas may be present between the transversalis fascia and the peritoneum,

If the duodenal lumen appears narrowed, a gastrojejunostomy may be necessary.

Complete tears or extensive lacerations
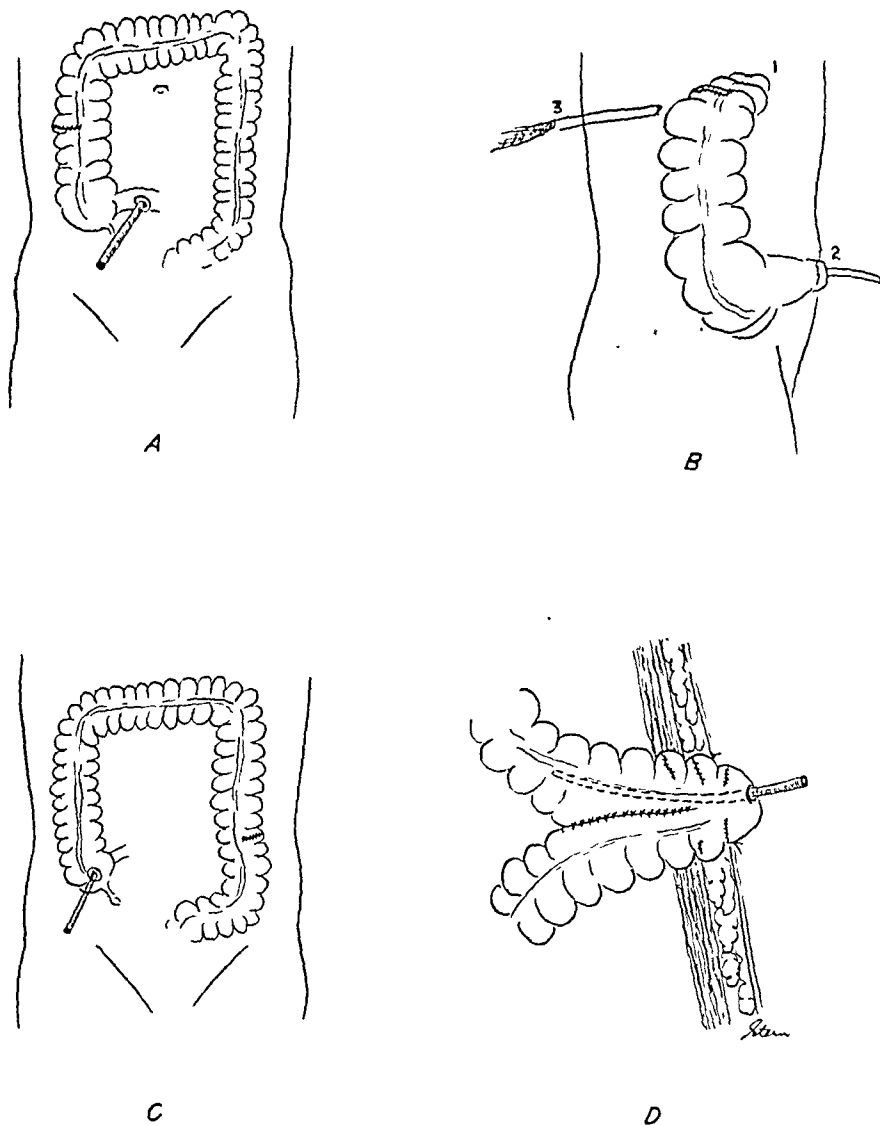
FIG. 22. A, repair of ascending colon and ileostomy; B1, repair of hepatic flexure, B2, cecostomy, B3, retroperitoneal drain; C, repair of descending colon and cecostomy; D, exteriorization of sigmoid and repair of lacerations.

and retroperitoneal crepitation may be palpated.[4]

Treatment. Exploration of the anterior and posterior surface and repair of the wounds. The posterior surface will require mobilization by means of a lateral incision along the outer border of duodenum and mesial retraction to expose its fixed retroperitoneal surface.

Suturing of small lacerations will suffice.

may require a Pólya or partial gastrectomy with closure of the duodenum.

JEJUNUM

This segment is more commonly injured by penetrating wounds. The jejunum may rupture as a result of sudden compression of gas due to a blow or compression against the vertebral column.[52]

Gross soiling and board-like rigidity may not occur until twelve to twenty-four hours has elapsed after rupture of the

supply to the stomach and small intestine is so abundant that one may contemplate almost any type of resection without com-
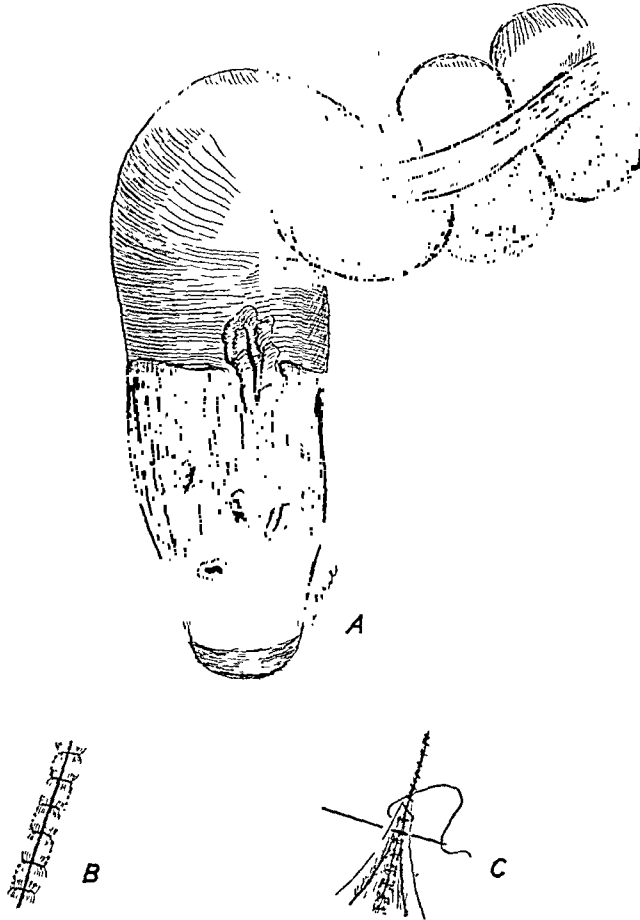
FIG. 23. A, rectal tears above and below line of peritoneal reflection; B, first row of sutures; C, second row of sutures.

jejunum.[3,52,58,71,76,86,96] This calm period is treacherous as it may obscure the diagnosis. The treatment is as described.

LARGE INTESTINE

Wounds of the large intestine are less common and less multiple than wounds of the small intestine.[2] (Fig. 21.) Injuries may vary from isolated contused areas to large perforations and ragged tears. The cecum, hepatic and splenic flexures are frequently ruptured by non-penetrating trauma.[23]

The blood supply to the large bowel arrives from three major sources; the superior mesenteric, the inferior mesentery and the internal iliac branches. (Fig. 19.) The blood

promising the vascularity of the remaining tissues. This does not hold for the large intestine. Extreme care must be taken in the placing of ligatures when resecting parts of the large bowel in order that the remaining bowel will not be endangered by inadequate blood supply.[90]

A large portion of this tract is retroperitoneal and perforations are frequently overlooked. (Fig. 20.) Retroperitoneal colonic injuries with subsequent infection of the connective tissue planes and muscles of the posterolateral abdominal wall are much more fatal than intraperitoneal wounds.

Treatment. A paramedian incision may be enlarged by lateral extensions for wound

of the flexures, ascending and descending colon. Retroperitoneal injuries can be approached through a muscle cutting flank incision.

3. Exteriorization (Fig. 22D) is indicated in extensive wounds of the mobile segments of the colon. Mobilization is necessary in wounds of the fixed sections of the
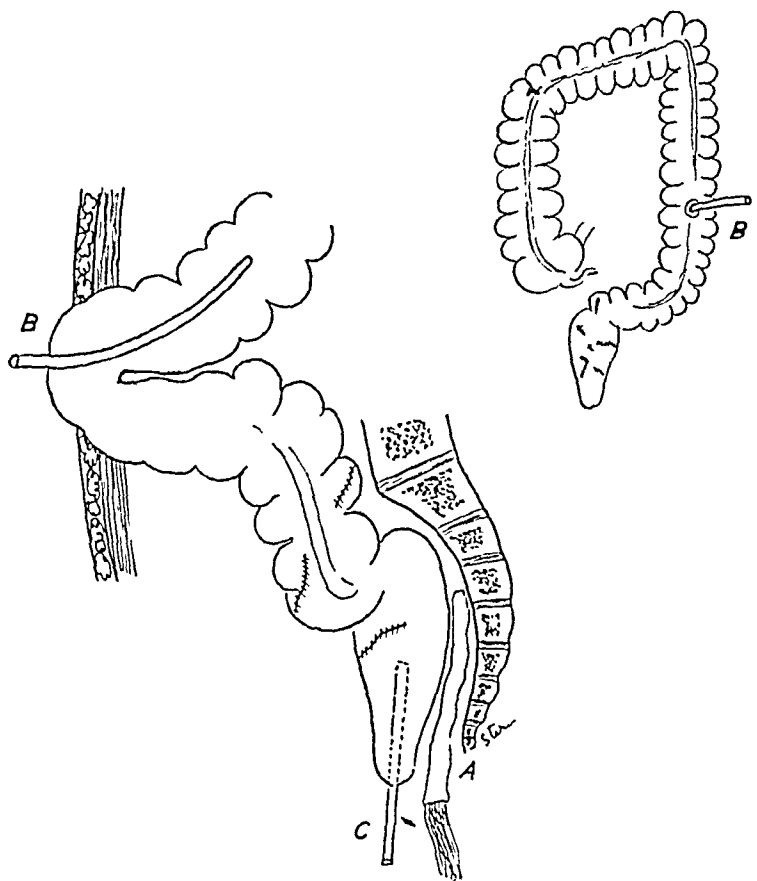
FIG. 24. A, retrorectal space; B, colostomy; C, rectal tube.

The treatment of colon injuries is based upon the known insecurity of sutures and the subsequent dangers of leakage.

1. Small tears may be sutured and covered with an omental graft. As a rule simple suture of large lacerations is unwarranted and dangerous.

2. Repair of lacerations and exclusion of the part by a proximal colostomy, cecostomy or ileostomy will provide for diversion of gas and fecal content. (Fig. 23A and B.) The colostomy should be brought out through a small separate incision. These small incisions hold the colon without sutures and allow rapid closure of the main incision. The colostomy may be allowed to function within a few hours after closure of the abdominal wall.

large intestine. The posterior surface of the colon without a mesentery is explored by opening the retroperitoneal space through a longitudinal incision in the peritoneum along the lateral border and reflecting the ascending or descending colon mesially. In addition to suturing of the posterior surface, closure of the peritoneum from within and establishment of a proximal colostomy, the retroperitoneal space is drained through a stab wound in the flank. (Fig. 22B.)

It is desirable to mobilize a long loop of the colon to facilitate its final closure. The two limbs of a well mobilized loop are approximated by a suture. The exteriorized colon should not be sutured to the ab-

dominal wall. A loop colostomy through the mesentery is preferable.

4. Extensive lacerations with loss of substance will necessitate a proximal colostomy to direct the fecal current and closure of the involved area. A second stage or definitive type of operation will be necessary at a later date.

Keene[49] advocates secondary end-to-end anastomoses of the disrupted colon at a later date.

RECTUM

Rectal examination is an important part of the physical examination and may reveal injury to the intraperitoneal, extraperitoneal segments, or both. (Fig. 23.)

Rectal wounds may be associated with wounds of the buttock, pelvis, flank and thigh. Gunshot wounds about the gluteal area, sacrum or coccyx require careful examination to rule out intraperitoneal injury.

Compressed air injected into the rectum may rupture the rectum.

Impalement injuries[24] are not uncommon. The frequency of injuries are favored by the funnel-like arrangement of the thigh surfaces, ischial tuberosities and soft parts around the anus; the anal canal being at the apex. The penetrating objects are directed to this apex, the anterior rectal wall and posterior bladder wall being frequently involved. Impalement of the rectum may occur directly through the anus or secondary after piercing the perineum.[100] The objects reported include pitchforks, picket fences, mop handles and horns of animals.[17] Impalement injuries may or may not injure the peritoneum.[78] The signs of peritoneal irritation may be slight or delayed. Perianal ecchymosis and lacerations may be coexisting.

Treatment. Laparotomy is indicated in all cases in which there is suspicion of peritoneal involvement. The following steps are carried out: (1) Débridement of the perineal wound, (2) repair of the bowel. The opening in the bowel is closed whenever possible, even though tears of the rectum below the peritoneal reflexion heal spontaneously. (3) Drainage of the retrorectal space. An incision lateral to the sacrum gives access to the pelvic-rectal cellular planes and permits drainage of the presacral space. (Fig. 24A.) (4) Colostomy. (Fig. 24B.) Wounds of the rectum, however trivial, require a proximal colostomy. A left inguinal colostomy is preferable. A transverse colostomy is utilized in rectal injuries that will require mobilization for its subsequent repair; thereby leaving the pelvic colon free and clear for the later operation. Prophylactic colostomy in perineorectal lacerations will prevent fistula formation. (5) Insertion of a rectal catheter will deflate the large intestine. (Fig. 24C.)

URINARY BLADDER

Wounds of the dome and posterior wall of the bladder are intraperitoneal, lead to peritonitis and may be complicated by wounds of the small intestine and pelvic colon. Extraperitoneal wounds involve the anterior wall, lateral walls and base of the bladder and may be complicated by compound fractures of the bony pelvis. The latter wounds are followed by urinary infiltration, destructive cellulitis and widespread necrosis unless drainage is promptly instituted.[89]

Clinical Features. Local pain is present if there is persistent extravasation of urine. A distended bladder suggests absence of leakage. Catheterization may reveal blood stained urine. Absence of urine is indicative of intraperitoneal extravasation.

Pathology. The lesions vary from small puncture wounds to extensive lacerations. Intraperitoneal lesions are often associated with injury to the small bowel or pelvic colon and frequently leads to peritonitis. Extraperitoneal lesions are often caused by a spicule of bone from a pelvic fracture and are associated with hematoma formation and urinary extravasation. The wound of entrance may be located in the sacral, gluteal and suprapubic areas, also in the hip, groin or perineum. Sometimes the punctures may be multiple and overlooked.

It is well to be sure that the dome of the bladder is not overlooked.[73] The causes of death are pelvic cellulitis, peritonitis and occasionally secondary hemorrhage from the pelvic vessels.

Treatment. Treatment combines the principles of wound excision and repair, supplemented by drainage of the bladder and cellular spaces of the pelvis.

The approach to the bladder is through a low midline incision extending to the symphysis pubis. Intraperitoneal wounds are sutured with two layers of catgut avoiding the mucosa.

Wounds in the rectovesical pouch may necessitate transvesical closure. Suprapubic cystostomy[81] will maintain constant bladder drainage. When bladder and rectal injuries are coexistent, cystostomy is performed prior to colostomy.

RETROPERITONEAL

Retroperitoneal hemorrhage may result from penetrating, non-penetrating, as well as "blast" injuries. These injuries may be limited to the retropertoneal spaces or be in combination with intraperitoneal lesions. Infection of the retroperitoneal tissues is severe and rapidly fatal due to the virulence of the anerobic flora.

Clinically there is pallor and progressive deterioration of the pulse without any evidence of peritonitis.[39] The pallor begins in the hands and subsequently extends to all exposed parts of the body. Various degrees of abdominal discomfort may be present with fleeting and inconstant abdominal tenderness and resistance.[36]

Hemorrhagic infiltration of the retroperitoneal tissues behind the parietal peritoneum, especially in the upper part of the abdomen, irritates the sympathetic ganglia and plexus. Ileus is quite common. Retroperitoneal hemorrhage usually absorbs without any treatment. Symptomatic treatment, of course, is indicated. Only when the hemorrhage appears to be increasing and shock deepening is operative intervention warranted. In the presence of infection operation is always indicated.

A hematoma may form rapidly or so slowly that it escapes notice until several hours after the trauma and therefore is unsuspected until pelvic cellulitis is fully established. Percussion dullness which does not shift with change of position is suggestive of retroperitoneal hematoma. The outer surface of the parietal peritoneum responds to irritation by the same mechanism and in the same manner as does its serosal lining.

Treatment. Conservative treatment is instituted if intra-abdominal injury can be ruled out. Hemorrhage from the large retroperitoneal vessels arising from the aorta and vena cava will require exploration and ligation of the bleeding points, with drainage of the retroperitoneal space.

An infected hematoma or a spreading cellulitis should always be incised widely to allow free drainage.

POSTOPERATIVE CARE

All patients with perforation of the gastrointestinal tract are treated as potential cases of peritonitis.[22]

Carefully recorded intake, output and electrolyte concentration with hematocrit and plasma readings will keep the patient in proper electrolytic balance and out of shock. Sedation, Fowler's position, oxygen inhalation and Wagensteen decompression with a Levine tube, or preferably a Miller-Abbott tube, are routinely instituted. 3,000 to 4,000 cc. of 5 per cent glucose in saline is administered intravenously every twenty-four hours. The necessity for whole blood transfusions will depend upon the hematocrit, red blood count and hemoglobin readings. Sodium sulfadiazine is administered intravenously, 6 Gm. daily, or sulfanilamide subcutaneously, using 150 cc. of an 8 per cent solution every six hours, a blood level of 8 to 10 mg. per cent being maintained.

Poth[77] and his associates favor the use of succinyl sulfathiazole, a maintenance dose of 25 mg. per kilo of body weight daily.

Penicillin[51] because of its rapid excretion, is given every three hours by the intra-

muscular route in doses of 30,000 Oxford units, if the organisms are susceptible thereto. Morphine, gr. ⅙, is given as often as necessary to control pain.

The Fowler position is used so that all drainage will go into the pelvis, where there is little motion and where abscesses can be readily drained.

POSTOPERATIVE COMPLICATIONS

Wound infection, peritonitis, pelvic abscess, subphrenic suppuration, retroperitoneal suppuration, postoperative atelectasia and thrombophlebitis are common sequellae to abdominal injuries. Their appearance is to be anticipated, so that sound rational therapy can be instituted at once.

CONCLUSION

Early recognition and immediate treatment of non-penetrating and penetrating abdominal injuries are essential.

The institution of shock therapy is preferable as a prophylactic rather than a therapeutic measure. Shock therapy always precedes surgical exploration unless there is continuous bleeding.

Preoperative preparation, the question of anesthesia, incision and operative procedures are discussed.

The operative technic cannot always be standardized and will depend upon the condition of the patient, the existing facilities and the multiplicity and severity of the injuries.

Wound closure, with or without drainage, and postoperative care is reviewed with firm emphasis upon the prophylactic use of penicillin and chemotherapy.

A plea is again made for the early recognition of postoperative complications and their immediate treatment.

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VARICOCELE*

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VARICOCELE is a varicosity of the pampiniform plexus and should be considered as detrimental a process to the testicle as varicose veins are to the lower limbs. It is a young man's ailment and rarely makes its initial appearance after the third decade of life. It is sometimes asymptomatic but usually such symptoms as low back pain, dull pains in the perineum and groin, feeling of weight and heaviness and sometimes sharp pains in the testicle are the chief complaints. In varicoceles of long duration the testicle on the affected side is considerably smaller than its mate on the unaffected side. This can be explained on the basis of poor circulation to the involved part. It has been the cause for rejection from positions which required fairly rigid physical examinations in civilian life and particularly in Civil Service.

HISTORY

The old operation of attacking the varices in the pampiniform plexus in the scrotum was unsatisfactory for several reasons: (1) The postoperative formation of fibrous tissue about the ligated venous stumps was bulky and heavy and was in many instances as offending as the original varicocele; (2) postoperative hematomas were common; (3) postoperative hydroceles (when the combined operation of excising the tunica vaginalis as well as the veins was not done) required further surgical intervention; (4) failure to correct the condition completely. The operation for the cure of varicocele was consequently not looked upon with favor and in a majority of cases it was shunned.

Two of our South American neighbors interested themselves in this subject and Bertola, in 1940, reported good results by separating the internal spermatic vein and its branches from the cord in the inguinal canal and transfixing these to the neighboring muscles. In work reported in 1941 and 1942 Bernardi developed an inguinal operation whereby the internal spermatic vein and its branches were ligated and cut at the internal inguinal ring through a 3 to 4 cm. skin incision. He reported seventeen cases with four immediate failures which he attributed to overlooking small accessory veins. Reoperation was successful in three of these cases and the fourth refused secondary operation. In 1944, Rudie employed the principle of venous ligation and the injection of sclerosing solution with good results. He exposed the spermatic cord through a small inguinal incision, ligated and excised a small segment of vein and injected the distal stump with 1 cc. of 5 per cent sodium morrhuate solution. During the same year Zucker reported good results by ligating the varices in the cord and transfixing them to the internal oblique muscle. Again in 1944 Javert and Clark in a preliminary report described a combined operation for varicocele and inguinal hernia. They found that of a series of 145 patients with varicocele, 25 per cent had an associated hernia. "Moreover, ten patients with varicocele and without a clinical hernia, had a hernial sac of varying size at operation, an incidence of 100%." They treated the varicocele by ligating the internal spermatic vein in the inguinal canal and the hernial sac was dealt with in the usual manner. The reports of all these investigators were uniformly good;

the patients remained symptomless and the varicoceles had vanished.

During the early months of 1945 we operated on fourteen patients with large matic varicoceles. The age range in this series was eighteen to thirty-one; three were thirty-one. The type of operation we employed was a combination of steps taken
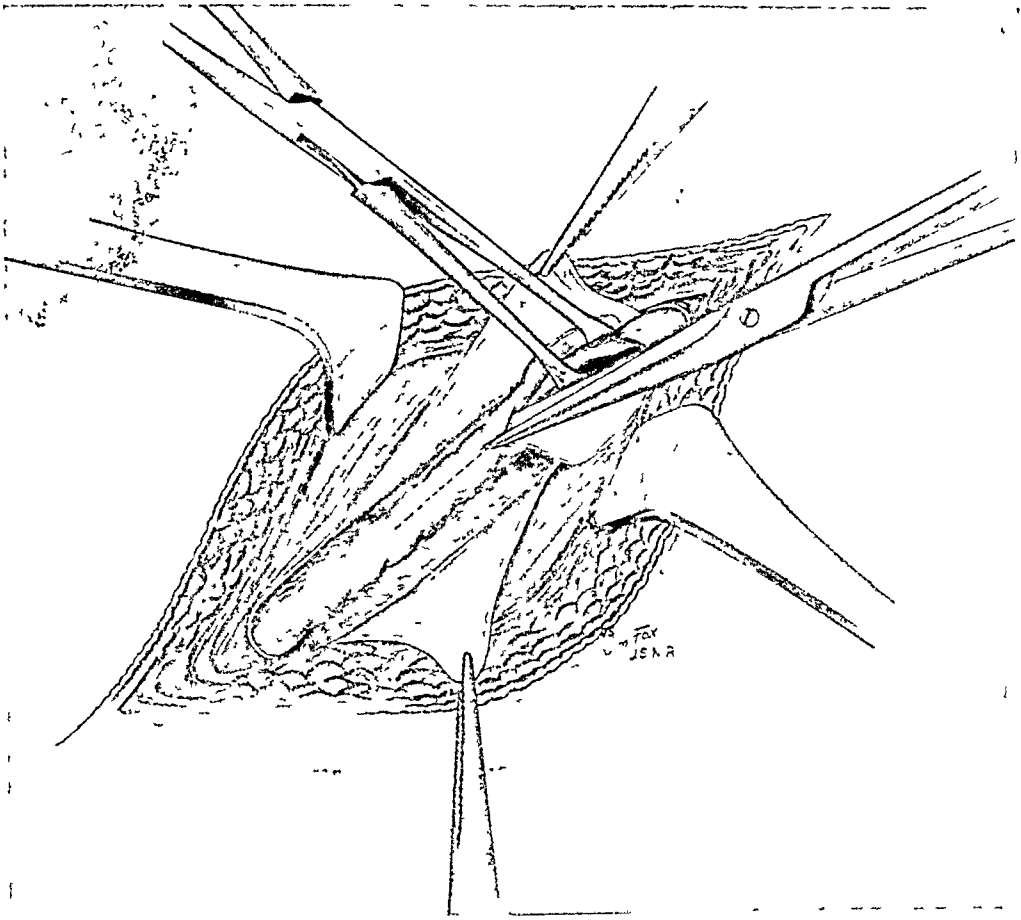
FIG. I. Cut edges of the external oblique aponeurosis are retracted and the inguinal canal and spermatic cord are exposed. Cremasteric fascia is incised; Allis forceps on contents of cord; external ring not opened.

symptomatic varicoceles at a U. S. Naval Hospital in the tropics, and later on we operated on another fourteen patients at the U. S. Naval Hospital, Shoemaker, California; a total of twenty-eight cases. These were all done via the inguinal route, employing the principle of preventing venous backflow into the pampiniform plexus by ligating the internal spermatic vein in the inguinal canal at the internal ring. The purpose of this paper is to report on our experience, the incidence of associated hernias and the postoperative progress of these twenty-eight young sailors who were operated upon for large sympto-

from operations previously described with some modifications, plus the use of the modified Bassini type of hernioplasty for reconstructing the inguinal canal.

OPERATION

Through a three-inch inguinal incision running slightly above and parallel to Poupart's ligament, the skin, subcutaneous tissue and Scarpa's fascia are incised and retracted from the underlying external oblique aponeurosis. The external ring and the cord emerging from it are identified. An incision is then made in the aponeurosis along the course of its fibers commencing

at a point about 1 cm. lateral to the ring, thereby leaving the arcuate fibers of the external ring intact. The cut edges of the

this is taken up with two or three sutures. The transversalis fascia and the conjoined tendon are then sutured to the shelving
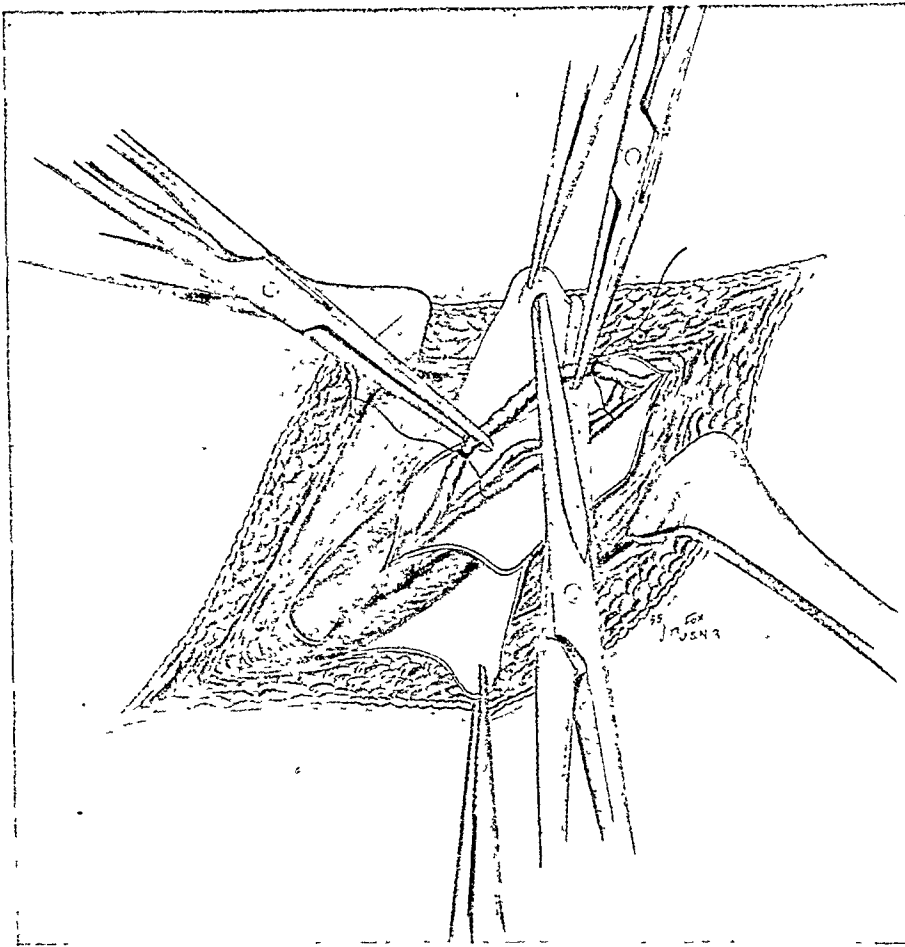
FIG. 2. Internal spermatic vein is isolated, ligated and a one-inch segment is excised.

external oblique are retracted and the inguinal canal and its contents are exposed. The cremasteric muscle is then incised and the elements of the cord are separated. In order to preclude injury to the vas deferens and the internal spermatic artery, these structures are first identified and retracted out of the field of operation. The enlarged and distended internal spermatic vein or veins are easily identified and bluntly separated from the surrounding structures. Careful search is then made for the presence of a hernial sac in the region of the internal ring. High ligation and excision is then carried out if one is found. If some slack is found in the transversalis fascia,

edge of Poupart's ligament. Kocher clamps are then placed on the offending veins and a one inch segment of vein is excised. The stumps are ligated and the ends are bound together. A needle is then threaded on the long ends of the ligature and the obliterated veins are sutured to the under surface of the internal oblique muscle. The elements of the spermatic funiculus are then reposited on the newly constructed floor of the inguinal canal, and the cut edges of the external oblique aponeurosis are either approximated or imbricated.

After the patient is placed in bed the testicles are supported by strapping a broad strip of adhesive tape across the

upper thighs. When no hernial repair has been necessary, the patient is allowed out of bed on the second or third day. When suture material has been very satisfactory. Tissue reaction and postoperative wound induration have been minimized by its use.
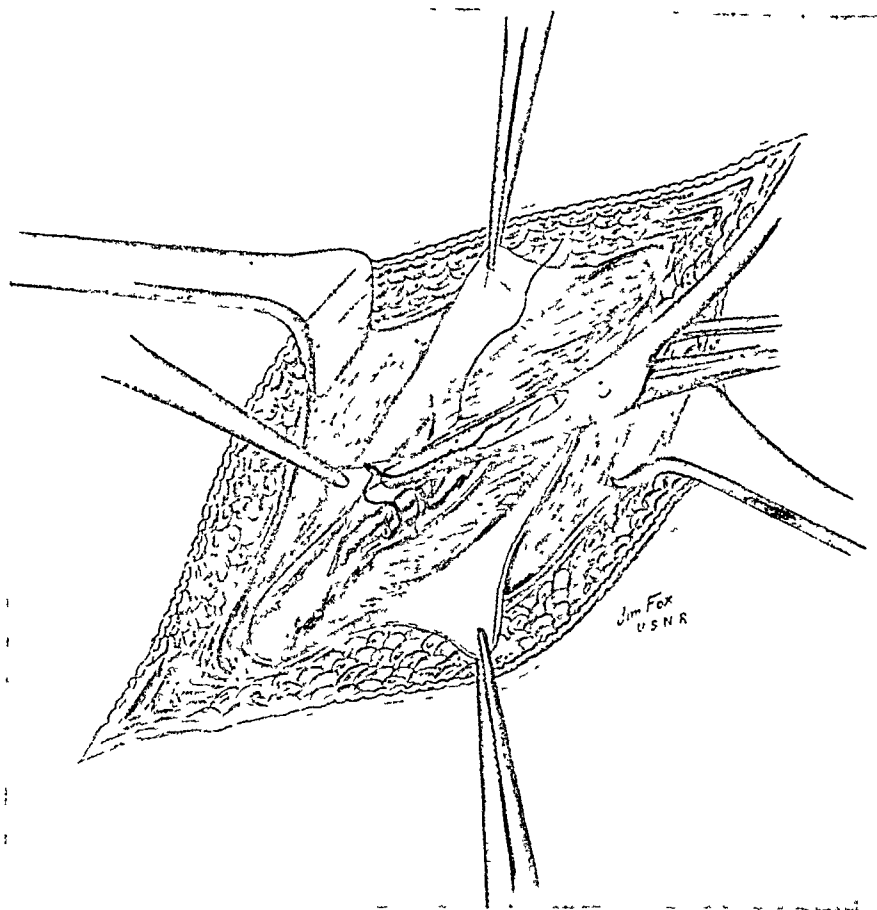
FIG. 3. Ligated stumps of the internal spermatic vein are bound together and transfixed to the under surface of the internal oblique muscle.

the combined operation has been done, the patient is allowed to remain in bed for six days. Patients are sent to duty in from ten to twenty days postoperatively. It might be well to point out at this time that the internal oblique muscle does not play a part in the reconstruction of the new canal on the grounds that satisfactory union is not had when "red" muscle tissue is sutured to "white" fascial tissue. Herniotomists of long experience have stressed the importance of uniting only" white" fascial tissue to "white" fascial tissue in order to obtain the good firm union so vital to the success of inguinal reconstruction. Our experience with the use of cotton

PERTINENT OPERATIVE FINDINGS

1. The internal spermatic vein was very often found doubled or bifurcated.

2. The internal spermatic artery (a branch of the abdominal aorta) was closely associated with the veins in the cord and great care must be exercised to avoid injuring it.

3. The external spermatic artery (cremasteric), a branch of the inferior epigastric, is distributed in the elements of the sheath of the cord. It is the chief source of bleeding in manipulating the cord.

4. A small indirect incomplete hernial sac was found in eight patients, seven of these being in the older age group (twenty-

eight to thirty-one). All had large varicoceles of from five to twelve years' duration.

5. The external ring was allowed to remain intact unless it was unduly relaxed.

DISAPPEARANCE OF PREOPERATIVE SYMPTOMS AND POSTOPERATIVE COURSE

1. *Preoperative Backache.* Backache vanished within twenty-four hours in sixty per cent of the patients who had this symptom before operation.

2. *Preoperative Sharp Testicular Pains.* These pains disappeared within twenty-four hours in two cases and did not recur within the postoperative period for two months.

3. *Preoperative Perineal and Groin Pains.* These pains vanished within twenty-four hours in three patients and did not recur in one month's postoperative observation.

4. *Postoperative Testicular Tenderness.* Seventy per cent of patients experienced testicular tenderness for a short postoperative period. Tenderness remained anywhere from two to fourteen days. Two patients experienced exquisite tenderness for four days.

5. Postoperative complications such as hydrocele, hematoma or testicular atrophy have been non-existent.

6. The varicocele completely vanished in from four to eight days in all cases.

CONCLUSIONS

1. The treatment of varicocele by inguinal ligation of the internal spermatic vein is based on sound anatomical and physiological principles and is the operation of choice.

2. Eight patients in twenty-eight had an associated inguinal hernia. These patients were in the older age group an incidence of 29 per cent.

3. The postoperative course is short and attended by a temporary period of testicular tenderness.

4. Cotton suture material has been used with a great deal of satisfaction.

5. Our experience and that of other investigators attests to the fact that satisfactory operation without disturbing complications can be assured in almost every case of varicocele.

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MANAGEMENT OF INTERTROCHANTERIC FRACTURES OF THE FEMUR BY SKELETAL TRACTION WITH THE BEADED KIRSCHNER WIRE*

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FRACTURES of the femur constitute a most important group of fractures, often associated with a high percentage of disability. The functional importance of the lower extremity is primarily that of weight bearing, and the shifting of weight bearing, namely, locomotion. Strict attention to functional anatomy is essential in the treatment of fractures of all types, and in the lower extremity of utmost importance. Every effort should be made to secure careful anatomical restoration of the parts in intertrochanteric fractures as well as in fractures of the neck of the femur.

In the past, the treatment of trochanteric fractures has often been neglected. It has been common understanding that, due to the vascularity of this area, these fractures can be handled by almost any method and healing will ensue. It is true that ultimate union is almost certain. However, malunion, with subsequent disability, has been fairly common, and the mortality from indifferent treatment unnecessarily high. With full effort directed at achieving maximum anatomical restoration, and with realization of the importance of the geriatric problems involved, we have treated a number of intertrochanteric fractures of the femur with skeletal traction employing the beaded Kirschner wire.

Intertrochanteric fractures are peculiar to elderly patients over the age of fifty. They constitute a high percentage of all the fractures of the femur. In a series of 526 cases of fractures of the femur reported by Speed, 124 were fractures of the neck, while 118 cases were fractures in the intertrochanteric region. Fractures of the trochanteric area result chiefly from trivial injuries, such as slipping or stumbling in the home, or on the street, the patient striking on the hip, or sustaining the fracture by what appears to be torsion, without direct violence to the trochanteric area. Intertrochanteric fractures are almost never compound. Separation of the fragments is not common, impaction of some degree being the rule. Displacement is usually present and produces a coxa vara deformity. This deformity is the result of separation of the fragments in the region of the greater trochanter with hinging of the fragments at the inferior end of the intertrochanteric line near the lesser trochanter. Outward rotation of the distal fragment, in relation to the upper, is common because these fractures are usually extracapsular. The lesser trochanter is frequently involved as a separate fragment, and is usually displaced upwards by the iliopsoas muscle. There may be considerable shortening due chiefly to a flattening of the neck angle.

PATHOLOGY

In our group of cases, several types of fractures were distinguished. The *first* of these, were fractures through the base of the neck of the femur, but outside the capsular attachment. Displacement was usually slight, and coxa vara deformity infrequent. In the *second* type, the fracture extended from the tubercle of the femur obliquely downward and medially along the intertrochanteric line. The distal fragment was rotated outwards and a gap appeared between the two fragments, with the angle opening upwards. Coxa vara of a

TABLE I

ANALYSIS OF EIGHTEEN CASES TREATED BY TRACTION WITH BEADED WIRE

Case	Sex	Age (Years)	Type of Fracture	Complications on Admission	End Results		Remarks
					Anatomical	Functional	
1. A. M.	Male	44	III	None	Bony Union Mild Coxa Vara	Good	.
2. C. S.	Female	72	II	Carcinoma of the Stomach. Hypertensive Cardio-Vascular Disease. Malnutrition	Bony Union	......	Died after 47 days of Congestive Heart Failure
3. E. S.	Female	76	V	None	Bony Union	Good	
4. E. M.	Female	80	III	None	Bony Union	......	Died after 57 days of a Pulmonary Embolus
5. J. W.	Female	91	I	Basal Cell Epithelioma of Forehead	Bony Union	Good	
6. K. M.	Female	83	III	Arteriosclerotic Cardio-Vascular Disease. Umbilical Hernia	Solid Bony Union	Good	
7. E. R.	Female	65	III	None	Bony Union	Good	
8. D. K.	Female	68	I	None	Bony Union	Good	
9. S. D.	Female	80	V	Chronic Nephritis	Bony Union	......	Died after 128 days of Congestive Heart Failure
10. M. F.	Female	78	III	None	Bony Union Mild Coxa Vara	Fair	
11. K. H.	Female	68	III	Arteriosclerotic Cardio-Vascular Disease. Diabetes Mellitus	Bony Union	Good	
12. C. M.	Female	55	III	None	Solid Bony Union	Good	
13. G. H.	Male	76	V	None	Bony Union	......	Died after 150 days of Bronchopneumonia
14. A. S.	Female	82	V	Subcapital Fracture Opposite Femur	Solid Bony Union	Good	Subcapital Fracture. Fixed with Smith-Petersen Nail. Patient discharged on crutches after 119 days.
15. J. V.	Male	84	I	None	Bony Union	Good	Slight amount of sero-purulent drainage from pinholes; ceased after short course of penicillin therapy.
16. V. P.	Female	85	IV	Hypertensive Cardio-Vascular Disease	Solid Bony Union	Good	
17. M. E.	Female	78	I	None	Bony Union	Fair	Wire removed because of large decubitus ulcer and pin drainage. Roger Anderson Well-Leg traction applied at 43 days.
18. M. L.	Female	80	I	None	Solid Bony Union	Good	

slight degree was usually present. In the *third* and commonest type, the base of the neck of the femur was driven into the

CLINICAL FEATURES

There are several clinical features which mark these fractures. The patient, usually

A B

FIG. 1. A, Case 15, J. V., aged eighty-four, illustrating a Type 1 intertrochanteric fracture, with fracture through the base of the neck outside of the capsular attachment. B, healing progressing with slight displacement and absence of coxa vara.

spongy mass of the trochanters. Extreme coxa vara was produced with marked outward rotation of the distal fragment. The lesser trochanter was frequently avulsed and separated from the main bony mass. In the *fourth* type, the fracture line involved both the intertrochanteric and subtrochanteric regions. There was hinging of the fragments with downward and medial displacement of the upper fragment, the gap opening laterally. This type of fracture has commonly been designated as the pertrochanteric fracture. The *fifth* type of fracture encountered, was similar to the previous type, with the addition, however, of avulsion and separation of the lesser trochanter. The shaft of the femur was frequently displaced upwards.

elderly, may complain of immediate pain in the hip, and inability to rise or stand on the limb. There are patients, however, who have been able to walk on the injured extremity. Examination of the limb will reveal the extremity in a position of marked external rotation, the degree of rotation being limited only when the foot is flat on the bed on its outer side. This is in contrast to the intracapsular fracture of the neck of the femur, where the tendency toward outward rotation is limited by capsular resistance. Mensuration of the limbs will show a shortening of the injured side of rarily more than one-half to one inch. There will be tenderness over the trochanter, which will be found to be lying well above Nélaton's line.

METHOD OF TREATMENT

Intertrochanteric fractures of the femur in the aged and debilitated are often

After a trial of the various methods of treatment of these fractures, we prefer skeletal traction by means of a beaded
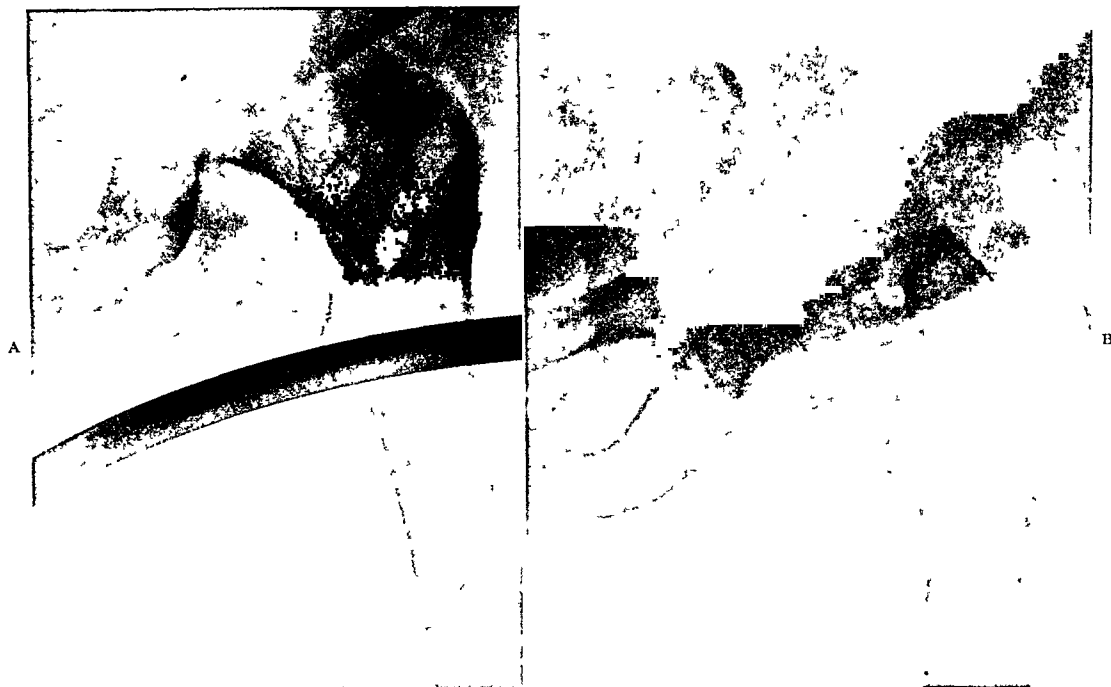
FIG. 2. A, Case 2, C. S., aged seventy-two, demonstrating a Type II intertrochanteric fracture. The fracture extends from the tubercle of the neck obliquely downward and medially along the intertrochanteric line. The distal fragment is rotated outwards and a gap appears between the two fragments with the angle opening upwards. B, showing healing after forty-seven days of skeletal traction with the beaded Kirschner wire. Coxa vara deformity is present. The patient died of congestive heart failure subsequent to a rather extensive carcinoma of the stomach. Traction was maintained with difficulty because of senile delirium.

terminal events. Many of these patients will die regardless of the method of treatment. In those who survive, healing of the fracture will invariably take place. With improper treatment, however, malunion and coxa vara will take place, leaving the patient crippled and bed-ridden, or entirely dependent upon crutches. Every effort should be directed at preventing any deformity which will handicap these elderly individuals who are, at their best, scarcely able to compensate for bony disproportion as well as the younger and more robust individual. The anatomical result of the treatment of any fracture is proportional to the accuracy of the primary reduction, the maintenance of that reduction, and the protection of the primary union against the elements of muscle spasm tending to cause displacement and rotation.

Kirschner wire inserted through the femur just above the condyles. The beaded wire employed is that used by Pease in the closed reduction of fractures of the tibia. It consists of a metal bead, five thirty-seconds of an inch in diameter, which is brazed to a plain Kirschner wire. Primary reduction is accomplished by traction in moderate abduction and internal rotation. The beaded wire is inserted through the medial aspect of the femur, and internal rotation is maintained by oblique traction attached to the wire, the bead preventing the wire from being drawn through the femur, also giving adequate purchase to the rotatory force, and preventing the wire from slipping from side to side.

Careful attention is given to the technic of insertion of the beaded wire, in order to avoid necrosis of the bone, and ulcera-

tion of the skin. The skin is shaved, and then cleansed with soap and water, and alcohol. The field is painted with iodine

the ordinary telescopic guide for the insertion of the wire because of the bead brazed on the wire. In order to steady the wire,

FIG. 3 A, Case 12, C. M., aged fifty-five, illustrating a Type III intertrochanteric fracture. The base of the neck appears driven into the spongy mass of the trochanters The lesser trochanter is avulsed and separated from the main bony mass Coxa vara deformity exists B, demonstrating healing of the base fracture and early union of the lesser trochanter No special effort was made to approximate the avulsed lesser trochanter.

and alcohol, and adequately draped with sterile towels. Sterile gloves are always worn. A point on the skin about three-fourths of an inch proximal to the medial femoral condyle is chosen, and a bleb raised with 1 per cent novocaine. The wire should not be driven through the condyles because of the soft cancellous nature of the bone in that area tending toward bony necrosis when traction is applied. An incision about one-quarter of an inch in size is made in the apex of the bleb. The skin is then pulled upward on each side while novocaine is injected down to and into the periosteum. The upward traction is made until the wire is fully inserted. The wire is driven through from the medial aspect of the femur by means of a cannulated hand drill. It is not possible to use

and avoid unnecessary motion, it is possible to insert the wire into the cannulated hand drill to a point where only a few inches of the wire is exposed at any one time. We have found the hand drill preferable to the motor drill for the insertion of the wire. It is possible to wind up the common peroneal nerve around the wire when the motor drill is used. When the point of the wire bulges through the skin on the opposite side, a second novocaine wheal is raised and the skin is again incised. The wire is inserted slowly until the bead meets resistance against the medial cortex. The tissues are then allowed to retract, and so pull away from the pin's inferior surface, minimizing the pressure on the soft tissues when traction is applied. No collodion or dressings are applied to

the skin about the pin. We have discovered through experience that the pin holes are sealed off very quickly by coagulation of

patient recovered from the initial shock of the injury. Then skeletal traction was employed as described. The traction force
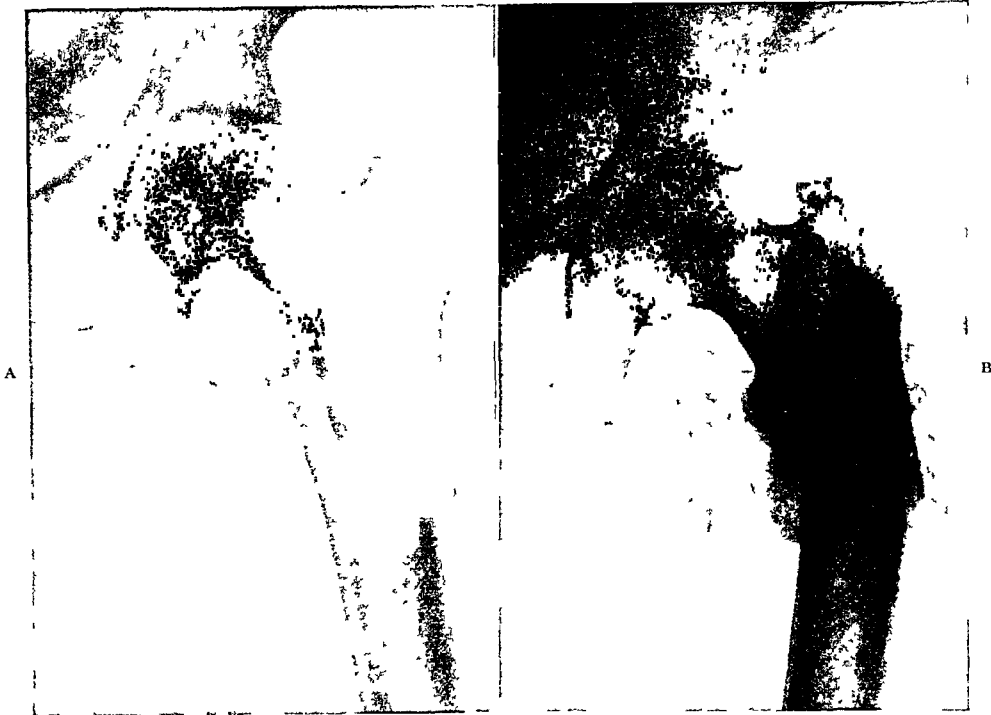
FIG. 4. A, Case 16, V. P., aged eighty-five, demonstrating a Type IV fracture. The fracture line involves both the intertrochanteric and subtrochanteric areas. There is hinging of the fragments with the gap opening laterally. B, illustrating healing with an abundance of bony callus. The patient's course was complicated with hypertensive cardiovascular disease.

serum, and that any dressing applied to the skin will only cause maceration and sloughing of the skin edges. In addition, the region about the pin is always available for inspection. A stirrup is applied with traction maintained in a vertical direction. In addition, separate traction to obtain internal rotation is maintained by applying the end of a separate rope to the lateral extension of the wire, internal to the attachment of the stirrup, and exerting this force by added weights in medial oblique direction.

This type of traction has been found extremely satisfactory in overcoming the displacement and the outward rotation of the shaft of the femur, and in the majority of cases, almost perfect anatomical reduction has been obtained. In several cases, we have applied the Russell type of adhesive traction for the first few days, while the

necessary at the beginning, is usually about twenty to twenty-five pounds, but after several days, the weight can be reduced to fifteen pounds, with four to six pounds for internal rotation. The thigh and leg are supported on pillows.

By this method of treatment, special attention may be given to medical supervision and nursing care, as well as the treatment of the fracture. This is of utmost importance in the handling of these patients, who commonly present nervous, cardiac, vascular, renal and other complications. The trunk and back are left entirely free, and the patient may be propped up in bed with a back support, and may shift at will from side to side. With frequent changes in position so feasible, hypostatic pneumonia can be avoided. The skin of the back and buttocks is easily accessible and can be easily cared for,

avoiding bed sores. Active and passive mobilization of the knee may be started early and continued during the entire tion of the lower limb, regardless of the method employed. We prefer skeletal over adhesive traction as a method of obtaining
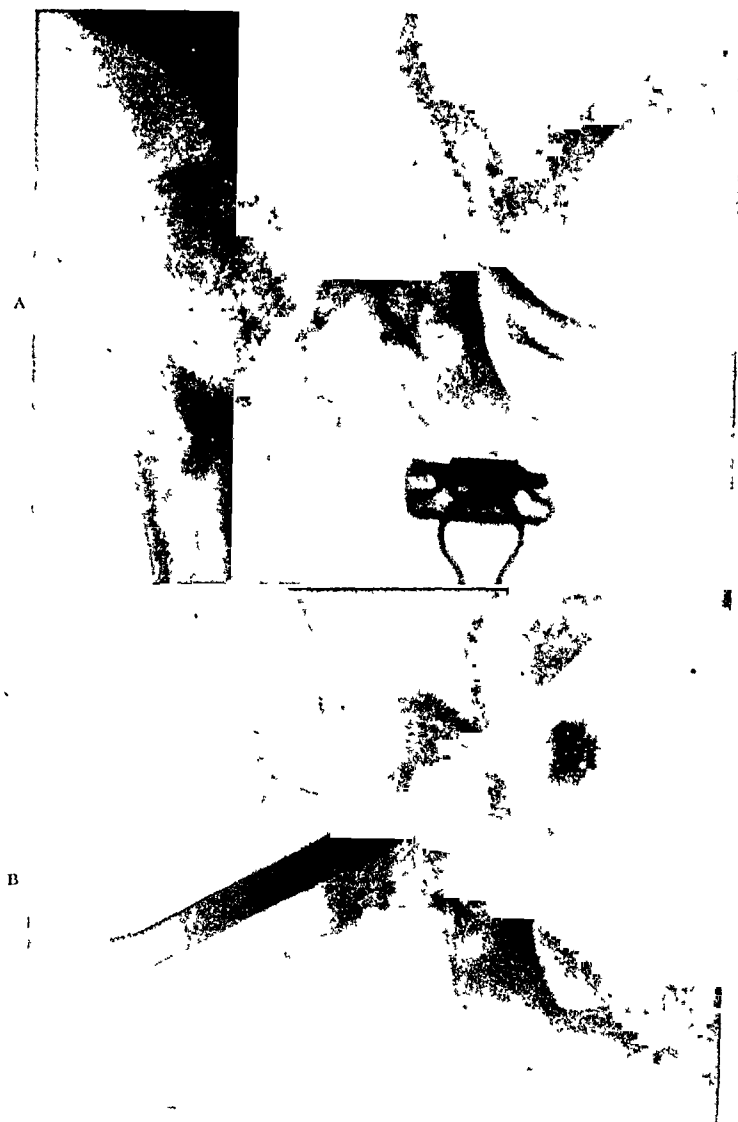
FIG. 5. A, Case 14, A. S., aged eighty-two, illustrating the Type v intertrochanteric fracture. This is similar to a Type iv fracture, with the addition, however, of avulsion and separation of the lesser trochanter. B, this patient also had a sub-capital fracture of the neck of the femur on the other side. The neck fracture was fixed with a Smith-Petersen nail. The patient was discharged on the 119th day on crutches.

course of treatment. This advantage is of considerable importance in cutting down the period of disability, inasmuch as painful stiffness of the knee is one of the more common causes of permanent disability in the elderly patient following immobiliza-traction, since it is not possible to obtain the necessary internal rotation of the shaft fragment by skin traction, and, too, considerably less weight is necessary for the reduction and the maintenance of position. In addition, the patients are more com-

fortable, and stiffness of the knee is avoided. Skeletal traction is maintained for from eight to ten weeks, following which, the patient is permitted to sit up in a wheel

beaded Kirschner wire. Our analysis showed good functional results and excellent anatomical restoration in sixteen of the cases with bony union in every case.

Fig 6 Illustrating the beaded Kirschner wire traction in the treatment of intertrochanteric fractures The wire has been inserted through the femur just above the condyles Traction is maintained in a vertical direct on, and in an oblique mesial direction to produce internal rotation Note the support of the thigh and leg by pillows The patient is comfortable and can be moved with ease without disturbing the forces of traction

chair. Weight bearing is not allowed for a period of six months, even though the x-ray usually shows evidence of abundant callus. The presence of such plentiful callus is misleading, and if weight bearing is permitted too early, the soft callus will bend, and coxa vara will develop, with considerable external rotation deformity and shortening of the limb.

ANALYSIS OF CASES

This review is based on a study of thirty-two cases of intertrochanteric fractures of the femur, seen during the past two years, eighteen, or 56 per cent, of which, were treated by skeletal traction with the

The age distribution of the patients varied from forty-four to ninety-one years, with an average age of 74.7 for the entire group. Of these, fifteen were female, and three were male patients. The youngest case was a man of forty-four, and the oldest male patient, eighty-four. The average age for males was sixty-eight years. Of the women, the youngest was fifty-five years of age, and the oldest ninety-one; the average age being seventy-six.

The incidence of the five types of fractures as previously described, proved to be as follows: Type I—incomplete, extracapsular, base of the neck or without deformity —five cases; Type II—intertrochanteric

only—one case; Type III—intertrochanteric with avulsion and separation of the lesser trochanter—seven cases; Type IV—pertrochanteric—one case; Type v—pertrochanteric, plus avulsion and separation of the lesser trochanter—four cases.

Complications of a medical nature commensurate with the age range of these patients were rather frequent. Four of the cases were burdened with cardiovascular disease. One patient was admitted with rather advanced carcinoma of the stomach, another a basal cell epithelioma of the skin of the forehead, and still another patient was a severe diabetic. Patient A. S., age eighty-two, had incurred a subcapital fracture of the neck of the opposite femur, in addition to a rather severely comminuted, Type v intertrochanteric fracture. This subcapital fracture was treated by fixation with a flanged Smith-Petersen nail under local anesthesia, and the intertrochanteric fracture was reduced and immobilized by traction with the beaded Kirschner wire. The latter patient was discharged on crutches after 119 days of hospitalization. It should also be noted that the majority of our patients were ward cases, many of whom were in a subclinical state of malnutrition.

The prognosis for intertrochanteric fractures has often been shown to depend chiefly upon the general condition of the individual patient. If the patient's general condition will permit recovery from the initial shock of the injury and the long confinement inherent in the treatment, the prognosis for the fracture is invariably good. Four (or 22.2 per cent) of our patients died. This mortality agrees closely with that of P. D. Wilson, and that quoted by Speed. The average age of the patients who died was seventy-seven years.

SUMMARY

Intertrochanteric fractures of the femur are common fractures in · the older age groups, and often upset the delicate hold that these patients have upon life, resulting in terminal complications. For those who survive the initial injury, healing of the fracture will take place. To prevent the bony disalignment and the deformity which results in the total, often terminal, confinement of these patients to wheelchairs and beds, every effort should be made to achieve complete anatomical restoration. Careful medical and nursing supervision is imperative, too. We have described a most successful method of handling these fractures by the reduction and immobilization of these fractures with skeletal traction employing the beaded Kirschner wire.

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INGUINAL HERNIORRHAPHY FROM THE INTRA-ABDOMINAL PERSPECTIVE

RETENTION OF THE SAC AND INTACT EXTERNAL RING, AND A MEANS FOR PROVING THE ADEQUACY OF THE REPAIR

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THE prevailing procedures for the cure of inguinal hernia emphasize the necessity for high ligation and complete removal of the sac, followed by reconstruction of the abdominal wall. The operation is done somewhat categorically in accordance with the type of hernia, and the erection of a barrier ·strong enough to prevent recurrence is the dominating thought. Under such circumstances there can be little individualization since the operation usually follows the pattern already prescribed for the group to which the hernia belongs. Every case, however, is a problem in physics and mechanics but without benefit of any means of measuring anatomical variations and constitutional deficiencies.

The literature on this subject is so replete because, without a suitable guide for each separate case, attention is centered on discovering what can be relied upon to remedy approximately similar anatomical defects. No provision is made for deciding during each operation what, if anything, must be done, nor at the conclusion whether the erected barrier will be adequate. It is possible that if a test for its success could be made so the outcome could be known with reasonable certainty, the surgeon would be less likely to depend upon any favored method. Neither would he have to wait for the passage of time, after it is too late, to approve his efforts. If the abdominal approach is used, such a trial is possible. Moreover, the class of hernia would make little difference since the peculiarities of each one, considered as a separate and distinct entity, could be

discovered immediately upon entering the abdomen.

The object of this communication is to consider inguinal hernias and their repair from the perspective of the same force which creates them. This is a reversal of the commonly accepted practice which, while acknowledging that the intra-abdominal pressure pushes the viscera through the abdominal wall, nevertheless completely ignores the effect of this force before and after the repair is completed. Thus no attempt is made to demonstrate the arrangement of the tissues with the intra-abdominal pressure in actual operation nor what rearrangement of these structures will take place, and how and where the expanding force will exert its influence after the original hernial route has been barred.

The direction of the approach to the problem of hernial repair has for some time impressed me as not being in accordance with the mechanical disposition of the physical forces involved. Reliance is now placed upon what is really only an estimate of the strength of the reconstructed abdominal wall for which there are no indicators except experience. This estimate is based upon the erroneous assumption that if the wall is firm to external pressure it will not yield to the thrust from within. It would seem to be more logical to attempt to find the weakness in the abdominal wall against a force applied in the direction that will reveal where its impact is greater than the restraining power. This is the expanding

pressure inside the abdomen and the approach should be from that direction.

These aims are accomplished by using the exploring finger inside the abdomen to duplicate the contents of the hernia before it is repaired; and after the repair, having the finger imitate the intra-abdominal pressure at the vulnerable points to discover any routes of recurrence and if the repair is firm. Then if inadequacies are discovered, they can be corrected before the operation is concluded. Harkins et al.[3] expressed surprise at how few surgeons will place the index finger through the open sac into the abdomen to explore the femoral ring and Hesselbach's triangle. Although they regard this maneuver as an essential feature of all herniotomy repairs, it is obvious that it cannot reveal the intrinsic soundness of the inguinal wall since the canal must be disrupted to reach that opening; nor can the strength of the repair be tested after this avenue is closed.

The leading advocate of the intra-abdominal approach to herniorrhaphy was LaRoque[5-8] who successfully used it in over 1,500 cases. It had on occasion been employed in instances of strangulation. Although there have been a few more proponents, its disadvantages were considered generally to be greater than its advantages.[4] One of the former, according to Bevan,[2] was the performance of an unnecessary laparotomy. LaRoque's primary objective was the disposal of the sac and redundant peritoneum with as little injury as possible to the muscular and fascial constituents of the inguinal area. In his method the sac was dissected and its neck closed first; if any repair was thought to be necessary, it was undertaken afterward. The essential difference between his procedure and the one I am proposing is that he failed to seize the opportunity with the peritoneum open, of testing the abdominal wall to find where the weakness, if any, may be; nor did he use this chance to discover if his repair was firm and adequate before the peritoneum was closed. It is my belief that if a suitable means is at

hand for making this test it should be given preference over the skill and judgment of anyone, regardless of how great these might be. There are other important differences: One is that the arch of the external ring is not divided and another, the sac is not only not dissected nor removed but deliberately retained for the security of the inguinal wall.

It may be well to state that LaRoque[9] condemned the peritoneal closure I am recommending but did not explain his antipathy towards it. Even if one does not follow this method of herniorrhaphy there are still the many other advantages of the transperitoneal approach that give the operator full control over any surgical opportunities or situations he may come upon.

The advantages of this approach stated by LaRoque and later amplified by Williams[11] are: (1) The sac can be easily emptied and removed, and its opening accurately closed. (2) Strangulated viscera can be examined after its return to the abdomen. (3) Intra-abdominal extensions of pathological conditions in the hernia can be discovered, i.e., contents which have been reduced during attempts before operation but were not visible. (4) Other intra-abdominal operations can be undertaken at the same time such as removal of the appendix or procedures on the female generative organs.* (5) Sliding hernias can be more easily repaired. (6) Repair of congenital hernias, which is difficult at times because of the thinness of the sac, is facilitated. (7) Undescended testicles can more readily be put into proper position. (8) All the structures on both sides

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* A hernia often can be repaired intra-abdominally during an operation performed primarily for other conditions. Once when removing an acutely inflamed appendix from a six-year old boy who also had a right inguinal hernia, the latter was cured by merely suturing the upper leaf of peritoneum to the lower border of the internal ring. There was no additional hazard since it amounted to nothing more than the required peritoneal closure. Similarly when working in the pelvis through a midline incision, the internal ring and the whole inguinal mechanism is accessible. I have taken advantage of that fact several times.

Intraperitoneal Approach
To Herniorrhaphy
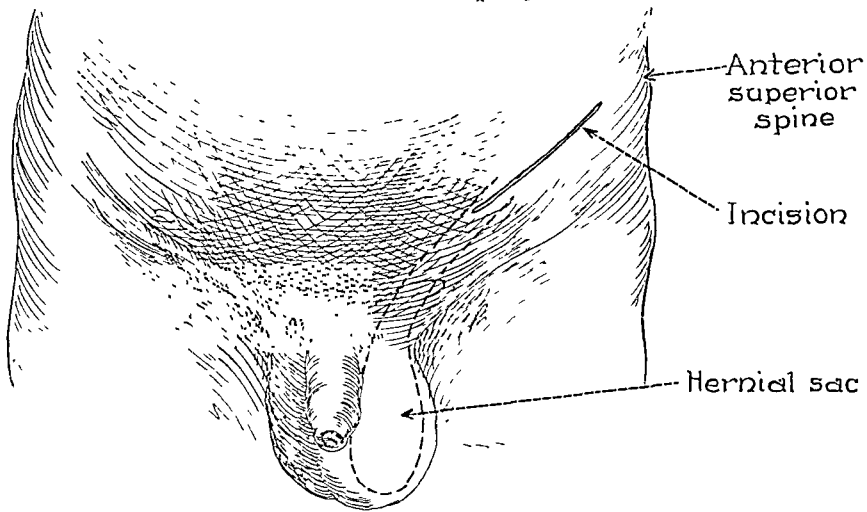
Fig. 1
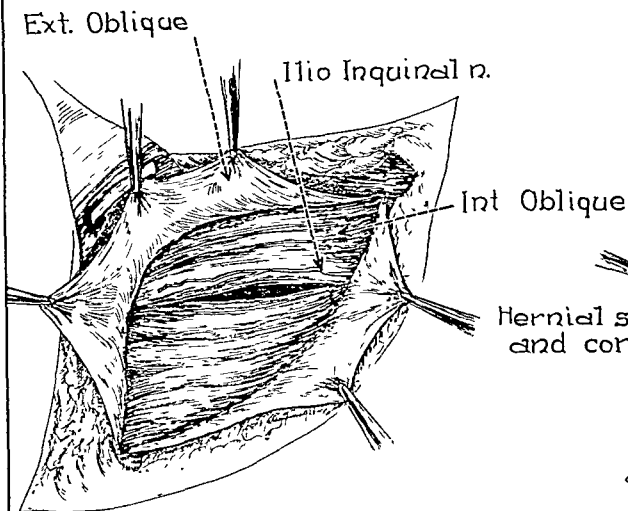
Fig. 2
Separation of Int. Oblique
begun just below nerve
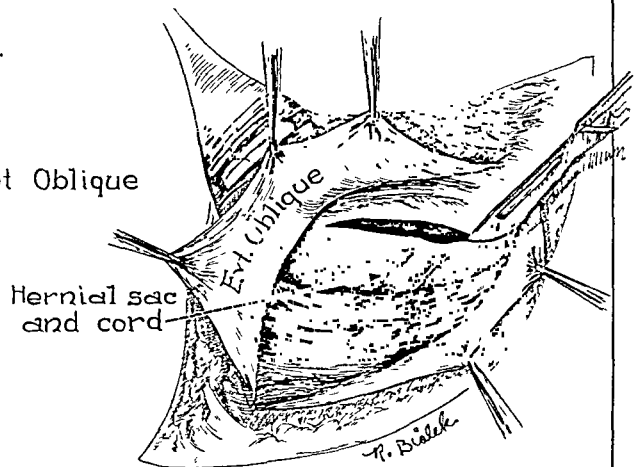
Fig. 3
Peritoneum incised, note
length and direction of
incision

FIG. 1. The incision need not be very long at first. If reconstruction is necessary, it can be lengthened to uncover the external ring. The external oblique is opened medial to the ring leaving the latter intact.

FIG. 2. Muscle separation is done below the ilio-inguinal nerve if that runs transversely or else just a little above where the muscle fibers begin to assume a fibrous character. It is not necessary to reach the peritoneum exactly at the internal aperture of the hernia.

FIG. 3. The peritoneum is opened transversely and clamps put on the angles for guides. Clamps are placed on the upper peritoneal edge, too, and left there, so it can be readily found when its closure is started.

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Intraperitoneal Approach To Herniorrhaphy

Fig. 4
Finger against ant.
abdominal wall, search-
ing for possible routes
of recurrence.

Anterior
superior
spine

Incision

Poupart's lig.

Ext. Inguinal
ring.

Symp.

Ext.Oblique

Opening into sack
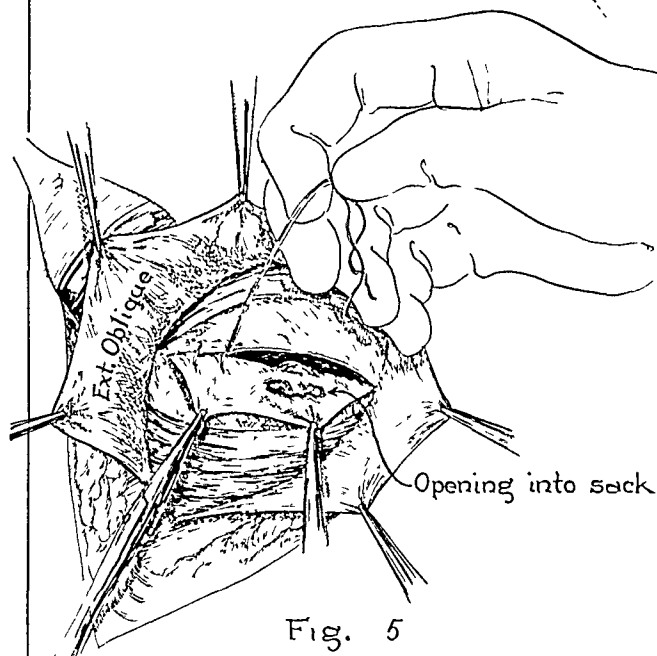
Fig. 5
Peritoneum sutured without dissecting
the sac from lower leaf

Ext.Oblique
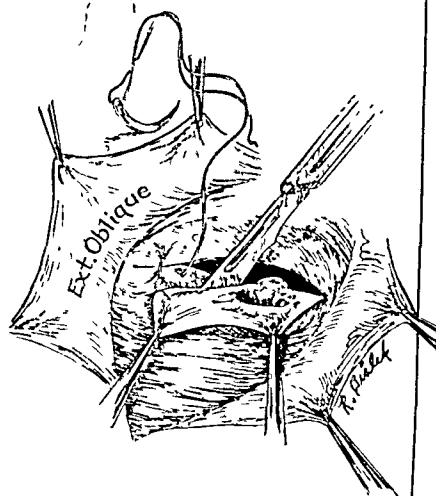
Fig. 6
Alternate method of suturing
peritoneum after dissecting lower
leaf, extraperitonealizing
Internal opening.

FIG. 4. After the finger has been in the sac to duplicate the hernia, it is removed and placed in the peritoneal cavity behind the sac to test the strength of the inguinal wall and search for all possible sources of failure.

FIG. 5. The closure is not started until all reconstruction has been finished and its stability proved by the maneuver illustrated in Figure 4. If reconstruction is required, the incision is lengthened to uncover the external ring allowing the fascia of the external oblique to be separated far enough to permit any necessary suturing.

FIG. 6. The alternate method of closing is seldom used.

Intraperitoneal Approach
To Herniorrhaphy
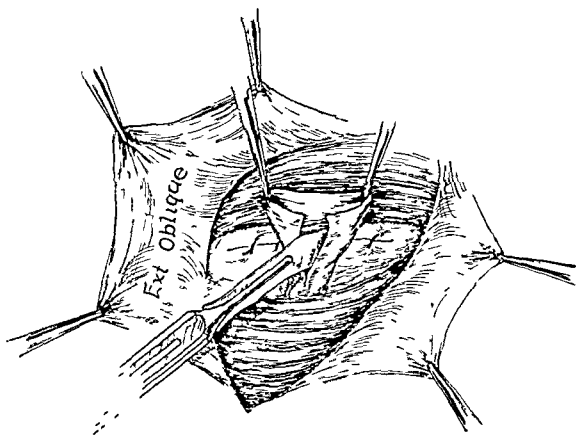
Fig. 7
Spreading of sac to facilitate
suturing neck of sac as a flat
surface to muscle
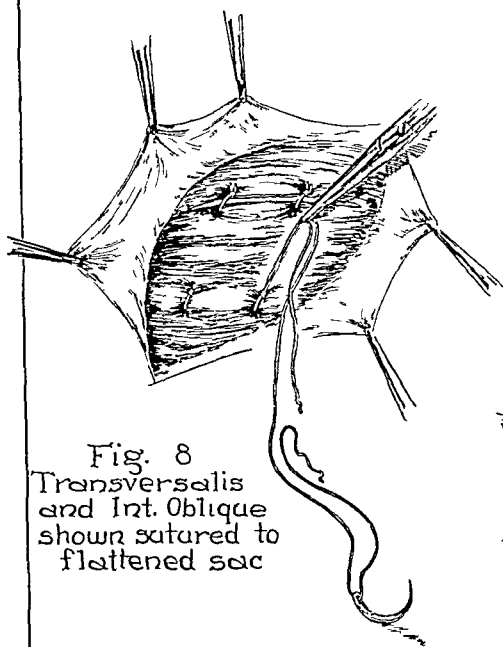
Fig. 8
Transversalis
and Int. Oblique
shown sutured to
flattened sac
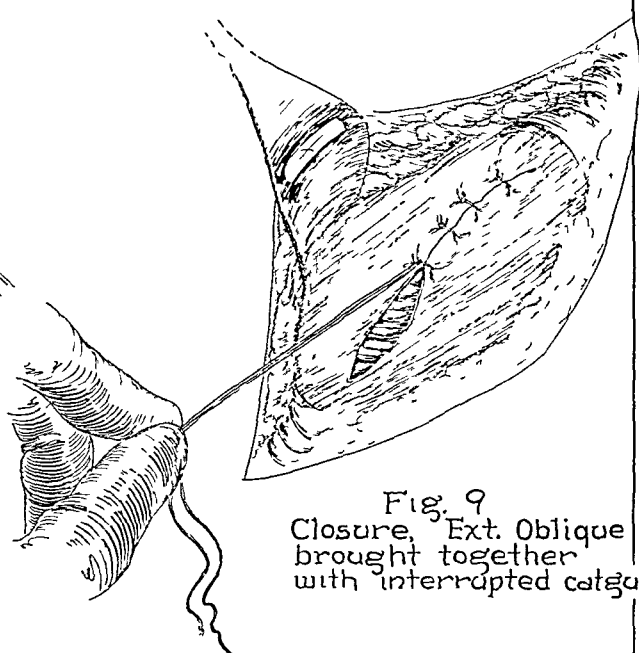
Fig. 9
Closure, Ext. Oblique
brought together
with interrupted catgut

FIG. 7. The neck of the sac is opened to form a flat surface of peritoneum. The incision into it under the muscles can be continued with scissors as far as can be conveniently reached. There is no danger of injuring the cord or its vessels since these are beneath the posterior surface of the sac. The distal part of the sac can be disregarded. However, the neck may be opened beyond the external ring exposing its peritoneum. This may be sutured to.the surrounding tissues with impunity to become a strong supporting structure, since its endothelial surface quickly disappears and is replaced by adhesions.

FIG. 8. The sutures uniting the transverse muscles pass through the peritoneal surface beneath it, thus bringing the cord forward and fixing the peritoneal closure. The distal sutures are used only when the sac is very large. If the neck of the sac is of sufficient width to spread from the inguinal ligament to the conjoined tendon at the pubis, it can be held in that position by fine sutures to these structures. Its elasticity will be cast off along with the other peritoneal characteristics and thus, by conversion into fibrous tissue, contribute additional strength to the inguinal wall.

FIG. 9. Closure; the external oblique is brought together with interrupted catgut.

of the peritoneum are under constant vision and, therefore, are less liable to injury.

The purposes for which I use the intra-abdominal approach, in addition to those already mentioned are directed just as much, if not more, at the diagnosis of what will be necessary to create an effective barrier against recurrence and to determine if the barrier has been erected, as they are to the facilities for managing the sac. These are: (1) The discovery of small hernias that, although causing discomfort, cannot be located clinically; (2) the study of the hernia which demonstrates accurately its mode of formation; (3) complete exclusion from the abdominal cavity, not closure, of the aperture through which the hernia passed; (4) the likelihood of redundant peritoneum and accessory sacs of initiating a recurrence; (5) the effect of the expanding intra-abdominal pressure before and especially after the hernia is repaired to demonstrate if the repair is firm and adequate. (6) the determination of what structures should be united or indeed, as is frequently the case, whether any should be joined; (7) the necessity for transplanting the cord; and (8) the type and disposition of the sutures.

PLAN OF OPERATION

The term "plan" is used because a method of procedure is followed without consistently employing any specific herniorrhaphy. More often than not, no reconstruction will be required. As much surgical discernment and understanding of the anatomy and physiology as well as a meticulous technic are demanded to carry it out, as has always been necessary. The predominating ideas during the operation are the investigation of the inguinal area to discover, after the hernia sac is emptied, if that part of the abdominal wall is able to retain successfully the intra-abdominal pressure, and if not, where and how to reconstruct it so it can.

An incision is made over the inguinal canal starting about one inch below the anterior superior spine and extending down over the external ring. The fascia of the external oblique is incised parallel to its fibers just internal to the medial limb of the external ring but the ring itself is not opened. The transverse muscles are exposed and the ilio-inguinal nerve sought. This nerve follows one of two courses: It either runs parallel to the fibers of these muscles or may take a proximodistal course. In either event the muscle fibers should be separated so as to prevent injury; in the first instance the opening should be made right below the nerve and in the latter it should be dissected so it can be moved toward the midline when the muscle separation is done. The fibers of the transverse muscles are separated down to the peritoneum which will be reached just a little above the internal ring. The peritoneum is opened transversely, too, and clamps placed at the angles to serve as guides when closing.

By lifting the distal leaf, the internal opening of the hernia can easily be seen and the lower border of this ring can be identified by its thickened peritoneum. Of course, if intestines or omentum are in the sac there is no difficulty; but if there is any doubt, the finger may be passed down the sac as an aid for recognizing this opening. I no longer look for it but just pass the finger into the sac because that is what follows in order that the hernia may be duplicated while the patient is recumbent. This border is then held with Allis clamps. The structures of the inguinal area are examined with the finger in the sac. The edge and thickness of the conjoined tendon, the width of the external ring with relation to the distance between the inguinal ligament and the insertion of the conjoined tendon, the position of the cord and the general solidity of the area can be made out. The finger is removed, then passed behind the sac and pressed against the parietal peritoneum of the inguinal area to determine its stability after the abdominal viscera no longer can have access to the original

hernial opening. The finger starts at the insertion of the rectus into the pubis and slowly and carefully passes laterally to the pubic tubercle, the superior pubic ligament, lacunar and inguinal ligaments, the spermatic fascia, and the area behind the cord including the femoral ring, all the time exerting pressure and probing for a weak place. If none is found, it may be assumed that the inguinal region is adequate and no reconstruction will be necessary.

The lower border of the internal ring is then used as the lower leaf of peritoneum to which the upper leaf is sutured for closing the abdomen. For this figure-of-eight suture No. oo catgut is used. The opening of the sac with its neck is thus settled completely outside the peritoneal cavity leaving not a vestige inside. To anchor it there it is opened ventrally down to the external ring making a flat surface of peritoneum out of the cylindrical neck and placing it immediately beneath the transverse muscles. This flat surface is caught in the interrupted sutures uniting these muscles. The external oblique and skin are closed. As the illustrations depict the operation for a simple indirect hernia thus becomes little more than the opening and closing of a low McBurney incision and the convalescence may be treated as such. There is no danger of tissues pulling apart since the only important suturing has been done in peritoneum and that adheres quickly.

When a weak place is found measures must be taken to strengthen it. In indirect hernias a space frequently is present between the conjoined tendon and the suprapubic ligament which may require one or more tantalum or steel sutures placed behind the cord to obstruct it. A strip of fascia from the external oblique may be used if that is preferred. Special attention should be given to this location; and if there is any doubt, its closure surely will do no harm. At other times the lacunar ligament in addition to the suprapubic must be used, but there has been no oc-

casion when I deemed it necessary to employ the inguinal ligament. What structures need to be joined are quickly revealed since with one finger in the peritoneal cavity behind the inguinal wall and another in front of it, the situation between them is sharply outlined; borders of tendons, ligaments and muscles become clearly delineated. The fingers serve also as ready guides for the suturing needle. When the suturing is finished its stability can then be tested by the finger inside the abdomen pressing against it. If it is sound and redundant peritoneum is unable to probe into it, the abdomen can be closed as before. The convalescence may be lengthened to some extent but need not be unnecessarily prolonged.

It will be found as a general although not an invariable rule that the weakness of the abdominal wall will be in direct relation to the distance between the internal and external rings, the latter being fixed. If the distance is short, the internal aperture is low and large, and the space between the inguinal ligament and the rectus muscle wide. Reconstruction more than likely will be required. When the distance is long, encompassing the whole inguinal canal, the hernia passes down the canal but does not exert pressure in the dorsoventral direction. The structural positions are such, that not having been subjected to prolonged stress and distortion, they can fully withstand the pressure from that direction and little or no reconstruction will be necessary. That is why children rarely require more than high ligation of the sac to cure a hernia. My experience with adults has been that size is no criterion of what has to be done and nearly half the hernias need no reconstruction whatever.

If the hernia is direct the exploring finger in the sac will be found pushing a pad of fat around the edge of the conjoined tendon which acts as a wedge between the conjoined tendon and the inguinal ligament. The tendon is shoved medially when this pad inserts itself between it and the taut

shelf of the ligament. A finger should be placed on the pad externally so as to invert the sac into the peritoneal cavity, through which the peritoneum of the most dependent part is caught with Allis clamps, pulling the sac into the peritoneal opening and the pad of fat up under the transverse muscles.

The finger in the abdomen will find an area to obstruct which occasionally is so large that some may consider it necessary to transplant the cord. The arch of the external ring can then be opened and the cord lifted out; the structures to be united are decided upon and the suturing done. In this situation it will be pleasing to note that, with the sac and fat pad completely out of the way without any dissection, the facility for maneuver is at once increased.

The firmness of the reconstructed wall may then be examined by the finger inside the abdomen. If it is found to be sufficient, the inverted peritoneum of the sac is used for the lower leaf, as in an indirect hernia. Its disposition is not the same and I have found it expedient to pass sutures through its apex and the original edge of the lower leaf when joining it to the upper leaf. The result is the affixing of the peritoneum of the inverted sac to the peritoneum of the abdominal closure, completely disposing of it. The pad of fat is well out of the way under the transverse muscles and may be disregarded.

However, when considered from the intra-abdominal perspective, there is little need during the repair to distinguish a direct from an indirect hernia. The cure for both depends upon the successful obstruction of a triangle which has for its base the suprapubic ligament and medial end of the iliopubic tract and whose sides are the inguinal ligament laterally and conjoined tendon medially. Even with the external oblique divided internal to the external ring, this area can be clearly exposed when the lateral leaf of the fascia is rotated outward. In a direct hernia this triangle may be relatively larger and require relaxation incisions into the rectus sheath to reduce tension, yet its surgical management can be practically the same as for an indirect hernia.

In either case, the cord may be dissected from its bed and retracted laterally exposing the weak transversalis layer beneath it. A strip of fascia taken from the medial leaf of the opened external oblique is left attached at its pubic insertion and used as a running suture between the conjoined tendon and the suprapubic and lacunar ligaments. Two or three loops of this suture, placed so as to obliterate the angle between the conjoined tendon and the pubis and catching the underlying transversalis fascia in its sweep, will make a firm bulwark which the exploring finger inside the abdomen cannot penetrate. The cord is forced upward to emerge from the apex of the triangle and when allowed to fall back upon the suture line, will not be affected by the closure of the external oblique as that will be medial to it.

Discussion of all the variables encountered in herniorrhaphies would unduly prolong this article. Strangulated, incarcerated, and recurrent, as well as reducible direct and indirect hernias have been done in this manner. I want to mention a type that has been somewhat intriguing: small hernias that are obscure clinically but produce intense discomfort. In one such case, the patient, a woman of fifty, had worn a double truss for years because of the comfort it afforded. She had repeatedly been refused operation because the hernia could not be seen or felt and she was thought to be neurotically magnifying her moderate abdominal ptosis. At operation the internal openings of the sacs hardly admitted the tip of the finger. Being barely an inch long it is not surprising they were not found upon physical examination. Their apertures were thickened and smaller in diameter than the sac and it could easily be seen that incarceration of bits of intestine or omentum was taking place. Relief was obtained by merely suturing these rings. The point germane to this discussion is that these hernias could not have been found nor

their characteristics revealed in any other way than by the intra-abdominal approach.

Lest the impression arise that this method is cumbersome and complicated, it may be said that it will be amazing, when once understood, how simply and fluently with a great saving of time, this plan for achieving the cure of a hernia goes forward and with what accuracy and certainty of result, barring surgical hazards, the inconstancies of the inguinal area can be rectified by any measures that are familiar to the operator. Two examples may be cited: In one the type of hernia could not be made out clinically and at operation an oval space about 3 by 1 cm. revealed at once through the abdomen, was found in the transversalis fascia just behind the upper part of the conjoined tendon Through it passed a large pad of fat but without a definite peritoneal sac. The cord was retracted medially, and with the finger in the abdominal side of the opening acting as a guide, the fat was excised and a running suture of fine wire on the exposed aspect was used to draw the edges together. Pressure upon it from within the abdomen disclosed that it was well able to support the intra-abdominal expansion. The patient has been clinically well for three years. The other was a large incarcerated indirect hernia. When the abdomen was opened, the omentum in the sac could not be retracted into the abdomen. A curved clamp with point upward was passed down the neck of the sac until it could be seen a little beyond the external ring where the sac was opened over it. A large mass of omentum was then resected at the level of the external ring and removed from the scrotum, whereupon that in the neck was easily withdrawn into the abdomen. This omentum could just as well have been resected at the internal ring. Ordinarily, some reconstruction would have followed but the finger in the abdomen demonstrated conclusively that with the sac empty the inguinal area was amply protected. Therefore, only

the internal opening of the sac was excluded from the abdomen and subsequent events have borne out the correctness of judgment. In this case an extensive herniorrhaphy would have been done if custom had been followed, since without the abdominal opening there was no way to show the strength of the abdominal wall. In addition a statistical cure for this herniorrhaphy would have been obtained in a case that did not need it.

This plan is particularly applicable in the aged and on any other occasion when the use of infiltration anesthesia is indicated. The sac is not dissected and there is less actual manipulation. For these reasons the duration of the operation is shorter. Furthermore such tension as must necessarily be exerted upon the peritoneum, omentum or intestines is toward and not away from the root of the mesentery and thus produces little if any discomfort.

COMMENT

The experience of investigating hernias from within the abdomen has suggested some changes in the herniorrhaphy procedure which require explanation. It will be observed that the sac, including the internal aperture of the hernia, is intentionally preserved, little attention is paid to redundant peritoneum and accessory sacs, and the arch of the external ring is maintained intact until its division is thought to be necessary.

Numerous studies of the anatomy of the inguinal region have been made to help solve the problems of inguinal herniorrhaphy. Of these one of the clearest and most detailed is that of McVay and Anson.[10] Concerning the inguinal ligament, they regard its use as illogical since it is not fixed and can be pulled up by rotation of the pelvis to leave the lower inguinal area completely unprotected. They conclude that it ought to be ignored and instead the suprapubic ligament (Cooper's ligament) should be united with the conjoined tendon.

Their findings can be confirmed by exploring the inguinal area through the transperitoneal route. This should be done with the external ring intact as its division will permit lateral rotation and deviation of the inguinal ligament with a concomitant increase in the distance between the lateral border of the rectus sheath and this ligament. When the ring, regardless of its size, is opened, a false impression of weakness is created and the relationship and mobility of the structures are changed. Since this arch is one of the strong stabilizing influences of the inguinal area, I seldom divide it.

The opinion that the sac of an inguinal hernia is not always a liability and may indeed be an asset contradicts, of course, a surgical dictum that is considered almost axiomatic. The fate of peritoneum left outside the abdominal cavity in large incisional and ventral hernias never has given me any cause for concern. On numerous occasions I have left the sac of an inguinal hernia intact and now do it in every case. Some of these were quite large and so far there has been no reason for regret. The prophets of gloom who expected it would become either a hydrocele or an avenue of recurrence have had no confirmation of their dire predictions. Banerjee[1] left the sac without even opening the end at the internal ring in over sixty cases and in both his experience and mine, although I do open this upper end, there has been no trouble. It may be that the endothelium loses its function and characteristics when not connected with the peritoneal cavity and the sac is obliterated by adhesions or the same mechanism that closes the funicular process in the fetus. From whatever cause, it quickly disappears and only a trace can be found a few days after operation although undoubtedly its components and attachments incorporated into the surrounding structures must still be present.

In addition to being unnecessary, it may even be detrimental to remove the sac. Regardless of the manner of dissection there must be some tearing of the fascias of the cord along with stretching and attenuation of muscle fibers that may permanently impair their ability to contract again, thus enlarging and weakening the whole inguinal region. I doubt, as some contend, that the fibrosis following this dissection more than compensates for the injury done. Moreover a structure is removed that, simply because of its presence, can be useful in the defense of the hernia. This will be better understood when considered in connection with the treatment of the neck of the sac.

In the procedures described, I stated that the internal aperture is excluded from the peritoneal cavity and not merely closed. These are not the same. When inside the peritoneal cavity, if the peritoneum around the opening is dissected, it will require a closure in addition to that of the peritoneal incision. The sac and cord become free and mobile allowing them to fall down the inguinal canal for a short distance. But if the upper leaf of peritoneum is joined to the peritoneum just below the internal opening to close the cavity, elimination of the sac from the peritoneal cavity is assured and only one line of sutures is required. The sac and cord do not descend and remain for the protection of the hernia. When the neck is opened a surface of peritoneum is brought directly into contact with the flat undersurface of the transverse muscles to which it adheres, carrying the cord forward with it. This wide attachment further limits mobility and strengthens the union of the muscles, fascias and cord, thus consolidating the whole inguinal resistance.

There is a difference, too, in the deployment of the peritoneum. Since the original hernial pathway has been completely excluded, an entirely new situation comes into existence. The intra-abdominal expansion is aimed, not down a canal but against the abdominal wall. Here the internal pressure will have to oppose it, the layers of peritoneum comprising the sac surrounded by its unharmed fascial and

muscular coats, in addition to the tissues already in existence. The pressure upon these is sustained, not by the inside elastic peritoneum but by the fibrous tissue of the diffuse external connections of the sac to the cremaster muscle and fascia, the internal oblique, and the transversalis and spermatic fascias. The sac and cord are left as a unit and continue to function as such. Non-interference in this area not only leaves the inguinal mechanism, which may be fully adequate, completely intact, but also does not destroy such capacity as it may already have, thus making rebuilding when required much more satisfactory. The intra-abdominal expansion can affect the inguinal wall in a manner that can be correctly predicted only when the latter is left undisturbed. It may be inherently competent to restrain this power as will be found so often when explored from within.

I believe that the importance of secondary sacs has been exaggerated. It is not unusual to find much redundant peritoneum in this area, so much sometimes that it may be assumed to be another sac. Suturing the neck of the sac in the manner I have described will eliminate much of this redundancy if that is considered helpful. However, if the accessory sac or redundant peritoneum cannot insinuate itself between any of the structures of the inguinal area, it will not be a source of recurrence. To reason that it will is to admit that the original hernia prevented the formation of a secondary hernia by this sac. Occasionally, secondary hernias are found but not nearly as often as accessory sacs.

It is not difficult to decide if a secondary sac or redundant peritoneum can initiate a recurrence. When the finger is placed in it after the herniorrhaphy is done and does not find any escape, it can be disregarded. But if an exit is found it must be closed. Removal of this sac does not reduce the elasticity and distensibility of the peritoneum. If an outlet is present, the peritoneum will find it. Hence it is necessary to interrupt the connection between the abdominal cavity and any potential hernial space. Hernias seldom recur because the sac has not been ligated high enough or excess peritoneum insufficiently removed. Failures may be due to the total inability of the structures to retain the intra-abdominal pressure but more often they originate from cleavages in the musculofascial layers through which peritoneum at first slowly slips and then gradually separates. It is the persistence of the intra-abdominal expansion against a vulnerable point which eventually produces the recurrence.

CONCLUSIONS

1. The intra-abdominal approach to inguinal herniorrhaphy is anatomically and mechanically correct and therefore superior to the extra-abdominal approach, now universally used.

2. Through it, every factor on both sides of the peritoneum including pressure phenomena, can be properly evaluated.

3. The large number of hernias which do not require any reconstruction for their cure can be accurately selected.

4. When reconstruction is necessary it provides a means for determining with precision what needs to be done, adequate opportunity for doing it and a way to demonstrate if the desired result has been accomplished before the patient leaves the table.

5. The sac and cord, with the fibrous attachments to its surrounding structures, when left acting as a unit, are useful for the protection of the inguinal region.

6. The sac, if allowed to remain, does not become a hydrocele or an avenue of recurrence.

7. As a result of investigating hernias from within the abdomen, the following changes in the herniorrhaphy procedure, are suggested: (1) The internal opening should be excluded from the abdominal cavity, not merely closed. (2) The external ring should not be opened until the necessity for it has been shown. (3) Dissection

of the sac should not be done as the unity of the structures defending the area is thereby adversely affected. (4) The upper part of the sac should not be discarded. Instead it can be transformed from a cylinder to a flat surface to be caught in the sutures closing the transverse muscles, thus converting it into a strong integrating and supporting agent.

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THE two most important structures that may be injured in femoral hernia repair are the femoral vein and the bladder. If the hernia is strangulated, an intestinal loop may be injured. These dangers may be avoided by carefully dissecting away all fat and areolar tissue about the sac before an attempt is made to ligate the neck of the sac or place the closing sutures. A few minutes spent in clearing the field and indentifying anatomical structures will aid in the prevention of operative errors.

From "Operations of General Surgery" by Thomas G. Orr (W. B. Saunders Company).

A DEVICE TO SIMPLIFY END-TO-END ANASTOMOSIS OF THE LARGE BOWEL*

THE ELIMINATION OF UNEQUAL DIAMETERS OF THE TWO SEGMENTS TO BE ANASTOMOSED

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ONE of the most troublesome problems, after resection of new growths in the large bowel, is to secure an

FIG. 1. 1, Tumor; 2, dilated proximal loop; 3, contracted distal loop; 4, Weber insufflator.

equal diameter of the proximal and distal ends to be anastomosed. As a rule this is because the bowel proximal to the tumor is dilated and that distal to the tumor the bowel is collapsed or contracted.

The unequal diameters of the two ends to be anastomosed can easily be overcome by the simple technic of dilating the bowel by means of air injected through the

rectum. A Weber insufflator such as that used in barium contrast enemas is employed. The air is injected after the

FIG. 2. 1, Proximal loop dilated; 2, distal loop dilated; 3, clamp to limit air to operative area.

abdomen is opened so that the amount of dilatation can be directly observed. The air flows easily up through the sigmoid, descending splenic flexure and into the transverse colon.

The following procedure is followed and it is applicable for tumors of the transverse colon, the splenic flexure, the descending and sigmoid colon:

* Read before the Society of Surgeons of New Jersey, January 30, 1946.

1. All patients are given a preoperative course of succynl-sulfathiazole therapy.

2. As soon as the patient is under anes-

three or four squeezes of the bulb are necessary to increase the diameter of the bowel considerably. The bowel distal
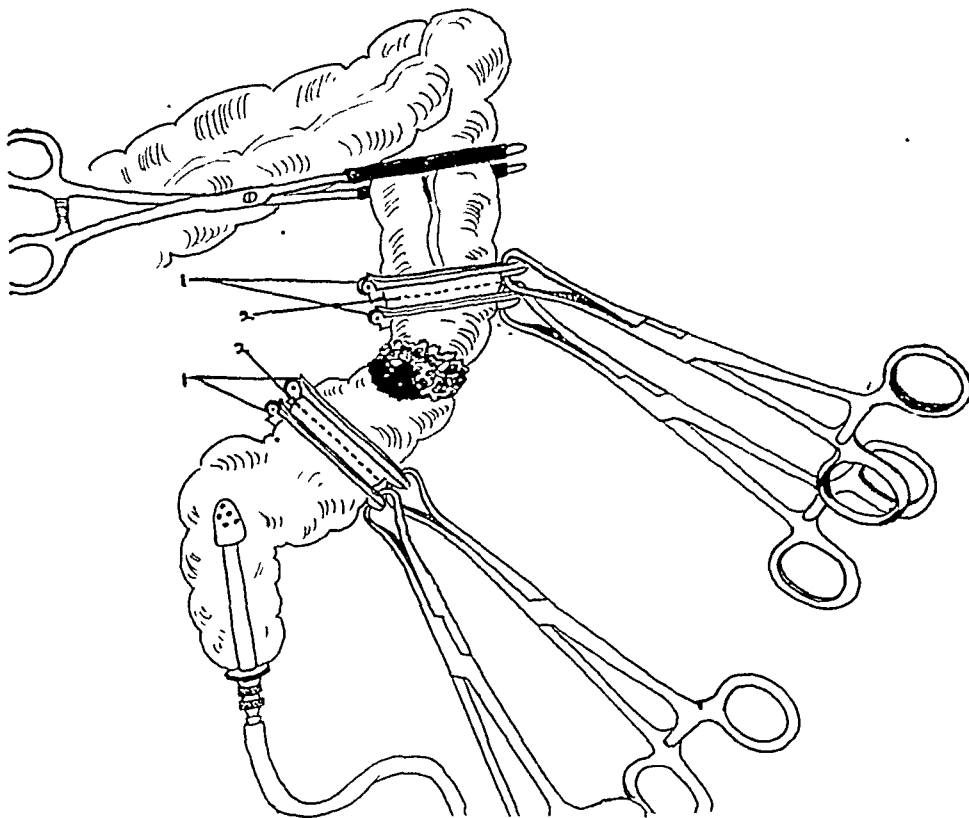
Fig. 3. 1, Double anastomotic clamps; 2, line of division by cautery.

thesia the insufflator is inserted into the rectum for a distance of about six inches. The bulb is left under the sterile drapes where it can be reached easily by a floating nurse.

3. The tumor and adjoining bowel to be resected are mapped out.

4. The mesenteric attachments of this segment are divided. All lymph nodes are removed; all vessels are ligated.

5. A rubber covered clamp is placed across the bowel about five inches above the proximal area to be anastomosed. This clamp prevents the air from going back into portions of the colon not involved in the operation.

6. Air is then pumped into the bowel by the floating nurse. This is done under direct vision and it is surprising how little air is necessary to dilate the bowel. Only

to the tumor sometimes dilates three to four times its former diameter. The air also passes through the segment surrounded by the tumor and dilates the area proximal to the tumor. Usually the lumen of the bowel above and below the tumor area are about equal.

7. Double anastomotic clamps are then placed above and below the tumor at the sites previously determined upon. By placing the anastomotic clamps on both the proximal and distal ends, while the bowel is dilated with air, makes it possible to secure an equal diameter of both ends. Both proximal and distal loops are then divided with the cautery. The tumor with its adjoining bowel is then removed.

8. The anastomotic clamps on the proximal and distal segments of the bowel are then approximated and the anastomosis

can be started. Rubber covered clamps are placed across the bowel on each side of the anastomotic clamps to prevent any spill. These are removed as soon as the suture of

9. The mesocolon is then repaired. Ten Gm. of sulfanilimide are introduced into the abdomen. The wound is closed without drainage; no retention sutures are used.
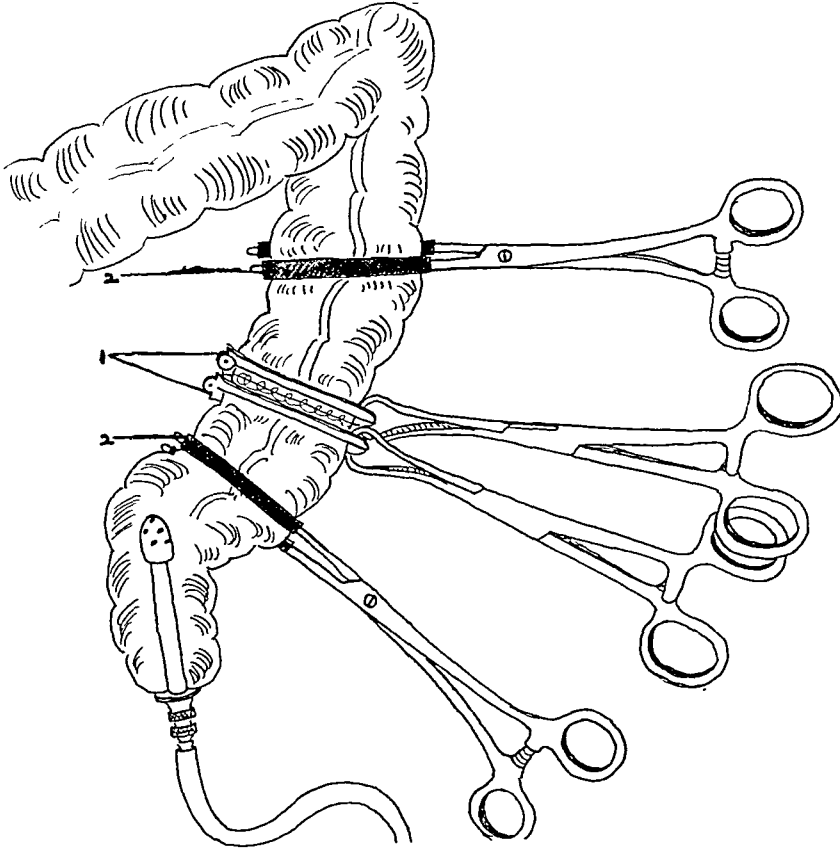
Fig. 4. 1, Proximal and distal clamps approximated, posterior suture; 2, rubber clamps to prevent spill.

the entire mucous membrane is completed. A posterior suture of silk or chromic dulox which includes both peritoneum and muscular coats is first introduced. This can be either continuous or interrupted. When completed, this posterior suture secures the desired diameter of the anastomosis. Even when the anastomotic clamps are removed and the air released the diameter does not shrink. The diameter is kept fixed by the posterior suture.

Any desired method of suturing can be used to complete the anastomosis. In our hospital we usually use three complete circles of sutures, each one outside and independent of the other two. The original posterior suture layer is continued on as the final anterior layer.

Postoperative Treatment. Nothing is given by mouth until gas is expelled, which is usually two to three days postoperatively. The patient is given 2,500 to 3,000 cc. of intravenous fluids daily; these include amino acids. One ampul of prostigmin is administered every four hours, and vitamins b and c are injected intramuscularly. Rectal irrigations, about three to five ounces, are given frequently, and intravenous sulfa medication and transfusions are also given if necessary.

SUMMARY

This method of securing adequate and equal diameters of the two bowel ends in end-to-end anastomosis has been used in a number of cases. It has been used in

carcinomas of the transverse colon, the splenic flexure, the descending and sigmoid colon. It can be used in any case in which there is room enough to place anastomotic clamps. We have had no accidents, no peritonitis, and no deaths in any of these patients on whom this method has been used.

We are usually able to obtain flatus on the second or third postoperative day. Occasionally, patients have had a bowel movement on the second postoperative day.

It is believed that this method of bowel dilatation can be a valuable adjunct in end-to-end anastomosis of the large bowel.

ENTEROCOLITIS is an inflammatory process involving the small and large bowel. Colitis is an inflammatory state of the large bowel alone.

From "Ambulatory Proctology" by Alfred J. Cantor (Paul B. Hoeber, Inc.).

Case Reports

TOTAL GASTRECTOMY FOR COMPLETE CARCINOMATOUS INVOLVEMEMT OF THE STOMACH

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TOTAL gastrectomy has been performed infrequently because of technical difficulties and the high operative mortality. In contrast, a great deal of experience with subtotal gastrectomy has been accumulated and is reflected in a decreasing mortality rate. The purpose of this paper is to report a case of scirrhous carcinoma of the stomach of the linitis plastica type, for which a total gastrectomy was successfully performed. In planning the type of operation required, it was thought that subtotal gastrectomy would be the one of choice. The finding at the time of surgery of a "leather bottle" type of stomach, necessitated total gastrectomy instead. This emphasizes the fact that total gastrectomy for carcinoma of the stomach cannot always be anticipated prior to surgery.

The necessity for careful preoperative preparation with special reference to combating anemia, protein deficiency, and the maintenance of a proper fluid balance is obvious. Scrupulous operative technic is essential and the adequate postoperative care of these patients is of the utmost importance.

A study of the literature on total gastrectomy indicates that there is considerable variance in operative technic. Willy Meyer[10] has described intrathoracic esophagojejunostomy employing combined abdominal and thoracic exploration for those cases in which the esophagus is involved and in which its adequate mobilization through the abdomen is impossible. Some authors believe that removal of the spleen is contraindicated. Others suggest that its removal does not materially add to the operative risk nor complicate the postoperative picture. This latter group states that if splenectomy improves the exposure and the ease with which the esophagus can be mobilized, it should be done without hesitation. The incision generally advocated is the high left paramedian or subcostal type. Little emphasis is placed on the incision except that all agree that it should be high.

There is a variance of opinion as to the use of jejunojejunostomy and also as to the necessity for draining the duodenal loop. Horsley[7] anastomoses the stump of the duodenum into the right half of the jejunal loop, thus providing drainage for the duodenum and preventing volvulus of the jejunum. Some authors believe that the use of the Levine tube is important and obviates the necessity for an entero-enterostomy or a jejunostomy tube. However, Lynch and Priestly,[8] Waugh and Neel,[15] Waltman Walters,[13] Chute and Albright[2] state that a jejunostomy tube is important for the protection of the anastomosis and also for early postoperative feeding. Willy Meyer[10] prefers the jejunostomy tube to an indwelling Levine tube passed through the anastomosis. Ducan[5] passes the Levine tube prior to the opera-

tion, then threads it into the distal loop of the jejunum after the anastomosis is completed.

It is interesting to note that there is considerable difference of opinion and a wide variation in the type of anesthesia recommended for total gastrectomy. Spinal anesthesia employing the continuous technic or Lemmon, or on occasion, the single dose technic, is advocated by Marshall and Zintl,[9] Graham[6] and Morton.[11] Wangensteen[14] on the other hand, advises the use of cyclopropane with an intratracheal catheter. Occasionally, however, this author employs spinal anesthesia supplemented by cyclopropane. Several authors advocate the use of field block of the abdomen, supplemented by a variety of agents or technics, including nitrous oxide and ether, splanchnic block, sodium pentothal, and ethylene (Waugh and Neel,[15] Crile,[4] Horsely,[7] Allen[1]). In a series of seventy-five subtotal gastrectomies Phelps[12] and his co-workers use an intratracheal catheter with an inflatable cuff employing ether or cyclopropane. Although this last series is for subtotal gastrectomy, the authors mention that the principles of the anesthetic technic advocated apply in all types of gastric surgery.

CASE REPORT

The patient was a forty-one-year old white male with over twenty-three years' service in the Army of the United States. He was admitted to Torney General Hospital on June 17, 1944, with the chief complaint of cramp-like pain in the epigastrium for a period of about six months. The present illness began in October, 1943, with slight periods of indigestion. The patient was perfectly well, however, aside from these discomforts and was able to go about his military duties until January, 1944, when he noticed cramp-like pain in the epigastrium accompanied by vomiting about every third or fourth day. Bowel movements had been regular all during this period. There was no hematemesis nor melena. The patient's normal weight was 167 pounds and was 130 pounds on admission to the hospital. From May, 1944, until the time of admission to this hospital, the patient was treated with an ulcer regime at another military hospital with considerable relief of symptoms. His previous history was essentially irrelevant except for psoriasis which he had since 1924. Previous surgery included a bilateral inguinal herniorrhaphy in 1941 with no recurrence. The family history was non-contributory.

Physical examination disclosed a white male 62½ inches in height, weighing 130 pounds with evidence of recent weight loss, but otherwise in fairly good condition. There were lesions typical of psoriasis on the buttocks, legs, chest, hands, elbows, arms and scalp. The remainder of the physical examination was normal except for slight tenderness in the epigastrium on deep pressure. No abdominal mass could be palpated. Blood pressure was 117/74.

Preoperative laboratory studies revealed normal urine analysis, a red blood cell count of 4.2 million, hemoglobin 95 per cent, white blood cell count of 17,150, and a differential of 62 per cent polymorphonuclear cells, 36 per cent lymphocytes and 2 per cent eosinophiles. Blood Kahn was negative. Gastric analysis showed 36 units of free hydrochloric acid and 68 units of total acid in the fasting specimen. Plasma proteins were 5.82 Gm. per cent and the icteric index was 5. Gastrointestinal roentgenograms taken on admission revealed a filling defect in the antrum of the stomach, approximately 6 cm. long extending to the pylorus. (Fig. 1.) The defect for the most part was on the greater curvature. The stream of barium through the defect was very narrow. This was constant when compared with previous gastrointestinal series taken seven weeks previously at another hospital. The x-ray diagnosis was carcinoma of the antrum of the stomach.

For two days prior to operation, the patient was prepared by nightly gastric lavages with dilute sodium bicarbonate solution and with intravenous therapy consisting of 1 liter of 5 per cent glucose in normal saline daily in addition to a soft ulcer diet. Thiamine chloride was also administered intravenously in doses of 50 mg. daily for these two days. On June 26, 1944, nine days after admission, the patient was subjected to total gastrectomy and splenectomy.

A transverse incision was made across the upper abdomen completely transecting both recti muscles. On the left side, this incision was extended upward at a right angle for about 6

inches. (Fig. 2.) The stomach was exposed and found to be much smaller than normal. The walls were heavily indurated and thickened. Grossly it had the appearance of a typical

encountered. This necessitated splenectomy. The common bile duct was exposed.

The first part of the duodenum just beyond the pyloric valve was then freed above

FIG. 1. Preoperative x-ray showing a large filling defect in antrum of stomach.

leather bottle stomach. (Fig. 3A.) Along the lesser and greater curvature, the texture of the stomach was rough. The great omentum along the greater curvature was thickened and indurated and gave the appearance of metastatic involvement. The first part of the duodenum was greatly dilated giving the impression of a diverticulum. There were strong fibrous adhesions between the first part of the duodenum and the omentum. The liver was smooth and glistening with no evidence of metastases. A few small glands were noted in the mesentery of the small bowel, two of which were removed for immediate microscopic examination and were reported as inflammatory. As the entire stomach from the duodenum to the esophagus was involved, total gastrectomy was elected. In attempting to expose the cardiac end of the stomach, enlargement of the spleen and dense adhesions fixing it to the cardia at the esophageal junction were

and below and clamped across with two crushing clamps. The duodenum was transected between clamps with the cautery. The distal end of the duodenum was inverted with No. 00 chromic catgut and reënforced with a second layer of Lembert sutures, and a third layer of interrupted silk. The duodenal stump was then buried into the head of the pancreas. The blood supply of the lesser curvature of the stomach was triply ligated with No. 0 chromic catgut and severed. Along the greater curvature most of the omentum was removed with the stomach. The stomach was elevated and traction was made downward exposing the esophagus. There was found to be approximately 1 to $1\frac{1}{2}$ inches of the esophagus which was available for anastomosis. There was no gross evidence of involvement of the esophagus in the carcinomatous growth. A long loop of the jejunum was isolated and brought up antecolic and anastomosed to the esophagus by a few inter-

rupted sutures of silk. A second posterior layer of continuous No. oo chromic catgut was placed and this suture was left attached and placed in

Before the abdomen was closed, a Miller-Abbott tube was passed by the anesthetist and threaded through the anastomosis between the

FIG. 2. Photograph of patient showing healed transverse incision with upward extension.

a sterile towel for future use. The jejunum was attached to the esophagus with the stomach *in situ*, employing the latter for traction. After completion of the two posterior layers, the esophagus was clamped across close to the suture line and transected with the cautery. An opening was made in the jejunum along the suture line corresponding to the open end of the esophagus. A running lock stitch of No. oo chromic catgut was used to approximate the mucosa of the jejunum and the esophagus and was continued anteriorly as a Connel stitch. This was then reënforced with a layer of Lembert sutures which was a continuation of the previously placed posterior layer. The two layers were then reënforced with an interrupted layer of silk. Silk sutures were placed on each side of the anastomosis to approximate the suture line to the diaphragm, thus preventing tension upon the suture line postoperatively. (Fig. 3B.) A piece of the omentum was brought up and sutured to and around the suture line for future reënforcement and safety. Sulfanilamide crystals were sprinkled in this area and around the closed stump of the duodenum.

esophagus and jejunum into the efferent loop of the jejunum (Fig. 3D) to prevent undue distention of the bowel postoperatively and to provide for postoperative feeding. The abdomen was then closed in layers without drainage.

Premedication consisted of 10 mg. of morphine sulfate and 0.4 mg. of scopolamine hydrobromide seventy-five minutes prior to the induction of anesthesia. Induction was accomplished with nitrous oxide and supplemented by ether, employing the circle filter absorption technic. Fifteen minutes after the induction of anesthesia, intratracheal intubation, employing direct vision with a catheter upon which an inflatable cuff was mounted, was performed. The cuff was then inflated to rest snugly against the trachea, thus isolating it from the pharynx and the esophagus. Preoperative blood pressure and pulse were 135/80 and 92, respectively. Except for a short period of hypotension of 80/60 due to traction on the stomach, the course was completely benign through the operation.

The pathological report was as follows: *Gross:* The specimen consisted of a stomach

amputated at the esophageal junction with the cardia and a small portion of the first part of the duodenum. The consistency of the wall

ently fibrous in character. The muscularis was hypertrophied. No tumor tissue was grossly evident. *Microscopic:* Sections taken from all
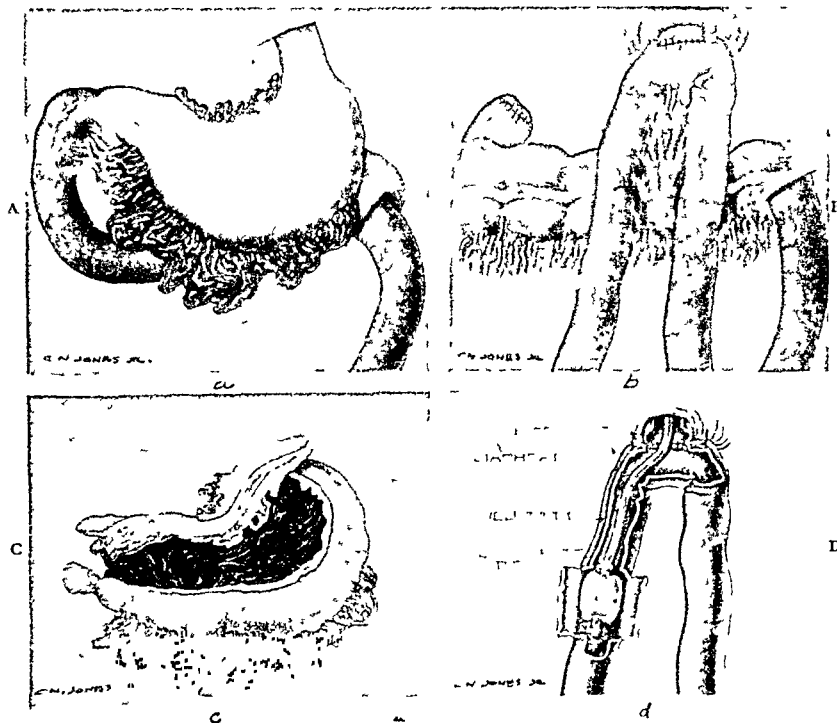
Fig. 3. A, gross appearance of stomach, typical "leather bottle" type. B, anastomosis of esophagus to jejunum showing silk suture along each side approximating suture line to diaphragm. C, stomach opened showing thickened and indurated walls. D, Miller-Abbott tube passed through anastomosis between esophagus and jejunum.

of the stomach was firm and stiff, being board-like in the region of the lesser curvature. These changes ended abruptly at the pylorus and the color and consistency of the duodenum were normal. The lumen of the stomach held about 130 cc. of fluid.

On opening the stomach, the mucosa was thrown into heavy folds, especially in the pyloric region. (Fig. 3C.) There was no fungating tumor mass and no definite ulceration. The wall of the stomach was very thick, measuring up to 1.5 cm. in the prepyloric region especially along the lesser curvature. The submucosa was thickened throughout, but especially in the pyloric and prepyloric regions, as well as at the cardia. The thickening of the submucosa of the cardia extended into the submucosa of the esophageal stump. This thickening was due to the presence of a whitish fibrous tissue which was very dense. It extended into the muscular coats separating individual muscle bundles. The subserosa was also thickened and appar-

portions of the stomach revealed essentially the same findings. The diagnosis is carcinoma of the stomach, diffuse, scirrhous type (linitis plastica).

Table 1 reveals in summary form, the postoperative regime which was followed, including parenteral therapy, drugs administered and observations of laboratory data. The salient points consist of the care in providing whole blood, protein, carbohydrate, water salt and the vitamins in proper quantities as well as exercising the usual precautions in the prevention of the postoperative complications common to gastric surgical patients.

After the immediate postoperative period, the patient did very well and was up and about taking progressively larger oral feedings. However, approximately three months after operation, signs of metastatic involvement in the chest and abdomen developed. The course was downhill from mid-September, 1944, until death occurred on October 21, 1944, (four months after operation) from extensive metas-

TABLE I

POSTOPERATIVE DATA

Date 1944	RBC	Hb	WBC and diff.	Platelets	Character of Red Cells	Urine	Intake	Medications	Remarks
26 June	..	...	.	.	....	..	1500 cc Plasma 500 cc Blood 1000 cc N/Saline 50 gm Glucose	Thiamine Chloride 5 mg.	Operative Day O₂ Tent
27 June	3.78	80%	17,900 92% Polys	.	Moderate poikilocytosis	Trace Glucose	1000 cc Plasma 1000 cc N/Saline 1000 cc 0.5% Saline 100 gm Glucose 50 gm Protein	Sulfadiazine gms 4 Thiamine Chloride 5 mg	O₂ Tent Cough Plasma Reaction
28 June				.		Normal	500 cc Blood 1000 cc N/Saline 2000 cc 0.5 " 150 gm Glucose 100 gm Protein 240 cc H₂O orally	Thiamine 5 mg. Sulfadizaine 4 gm. 100 mg. Vit. C	Blood Sulfadiazine 6.7 mg. O₂ Tent Plasma Reaction
29 June	4.38	90%	16,800 73% Polyps	..	Normal	.	2000 cc 0.5% Saline 1000 cc Distilled H₂O 1000 cc N/Saline 250 gm Glucose 100 gm Protein 400 cc H₂O orally	Sulfadiazine 4 gm. 10 mg. Thiamine 100 mg. Vit. C	O₂ Tent Temp. Normal
30 June	..			..	...	Heavy Trace Glucose	2000 cc 0.5 Saline 1000 cc N/Saline 150 gm Glucose 100 gm Protein 300 cc H₂O orally	Sulfadiazine 4 gm 100 mg. Vit. C 10 mg. Vit. B	O₂ Tent Serum Prot 4.98 A/G ratio 1.6/1 Blood Chloride 455 mg.
1 July	4.03	90%	7,280 74% Polys 24% Lymph 2% Eosin	196,000	Normal	Glucose	1000 cc Dist. H₂O 3000 cc 0.5% Saline 250 gm Glucose 150 gm Protein 400 cc H₂O daily	Sulfadiazine 4 gm Thiamine Chl. 20 mg. Vit. C 100 mg.	Bl. Sulfa 3.7% O₂ Tent
2 July	...	..	. .	.	.	.	2000 cc Dist. H₂O 1000 cc N/Saline 200 gm Glucose 400 cc H₂O orally	Vit. C 100 mg. Thiamine 10 mg.	O₂ Tent discont. Sulfadiazine cont.
3 July	4 07	90%	7,600 65% Polys 33% Lymph 1% Eosin 1% Baso	208,000	Normal	Nromal	2000 cc Dist. H₂O 1000 cc N/Saline 1000 cc 0.5% " 300 gm Glucose 50 gm Protein H₂O freely orally	Thiamine Chl. 20 mg. Vit. C 100 mg	"Hunger" pains
4 July	...	...	....	....	. . . .	. .....	1000 cc Dist. H₂O 1000 cc N/Saline 1000 cc 0.5% " 200 gm Glucose 50 gm Protein H₂O freely orally	Vit. C 100 mg Thiam. Chl 15 mg.	
5 July	....	...	....	....	....		1000 cc 0.5% Sal. 50 gm Glucose 50 gm Protein supplemented with strained fruit juices and broth.	Vit. C 100 mg.	Miller-Abbott tube removed. Stool.
6 July	4.00	80%	9,400 74% Polys 26% Lymph	203,000	Normal	Normal	O.K.	....	Serum Prot. 4.95 gm A/G 2.6/1
7 July	....	....	... .	....	. ...	....	....	....	Retention sutures removed. Hematoma of wound.
8 July	4.41	85%	8,900 61% Polys 31% Lymph 3% Eosin	204,000	Normal	Normal			
10 July	4.38	85%	8,300 60% Polys 26% Lymph	28,200	Normal	Normal	....	Liver ext. 2 cc I.M. every week	
11 July					Lab data normal from this date to present date of 8 August 1944				Out of bed.

tases to the peritoneum, both pleurae, and the abdominal lymph nodes, verified at autopsy. The esophagojejunal anastomosis was patent.

COMMENT

The case reported is presented not because of its rarity, but because it demonstrates a number of interesting features which are of general interest. This case exemplifies the fact that the necessity for total gastrectomy cannot be anticipated prior to laparotomy for carcinoma of the stomach. Because of the radiographic evidence, it was thought preoperatively that a subtotal gastrectomy would be the operation of choice, and that there would be ample normal stomach to make this procedure feasible. However, when the abdomen was opened, the stomach was of the "leather bottle type" and completely involved. It was necessary to perform a total gastrectomy or close the abdomen without further operative interference. The former was elected.

The type of incision used in this case proved to be very useful and gave excellent exposure. To our knowledge, the incision described in the section on operative technic has not been reported previously. Mobilization of the left lobe of the liver was obviated as a result of the exposure afforded by the incision. The wound healed by primary intention and there was no evidence of a postoperative hernia nor weakness of the abdominal wall. (Fig. 2.)

In this case the Miller-Abbott tube was inserted at the time of operation and was threaded through the esophagojejunal anastomosis and passed into the efferent loop, obviating the necessity of performing enteroenterostomy or jejunostomy. Subsequent results justified this decision and unquestionably had a marked influence on the smoothness of the postoperative convalescence.

Splenectomy was necessary to permit adequate exposure of the esophagus as the spleen was densely adherent to the cardia by strong fibrous adhesions. The spleen was removed without incident and did

not add to the operative risk or apparently complicate the postoperative blood picture.

The postoperative roentgenogram revealed a well functioning esophagojeju-

FIG. 4. Postoperative x-ray showing well functioning esophagojejunostomy.

nostomy. (Fig. 4.) There was some compensatory dilatation of the esophagus which explains the patient's ability to tolerate feedings without distress. It was anticipated that in time the jejunal loops would also participate in the dilatation.

In considering the method of anesthesia, the technic employed was selected because of certain advantages. The intratracheal tube with an inflatable cuff isolates the pharynx and the esophagus from the trachea, and thus prevents aspiration of gastric contents, during manipulation of the stomach and minimizes the opportunity for postoperative respiratory complications. From the standpoint of the surgeon, this method of anesthesia provides

for adequate relaxation of the abdominal wall and for smooth operating conditions, while maintaining absolute control of the airway. Finally, the employment of this type of intratracheal catheter facilitates the passage of the Miller-Abbott tube during the operation. This is considered the ideal time for this procedure.

It is apparent that a vital factor in the success of total gastrectomy is the proper management of the complications induced by enforced starvation and all its implications. Strict attention to nutritive demands pre- and postoperatively is required. This means the intelligent and carefully controlled administration of whole blood, water, salt, protein, carbohydrate and the water soluble vitamins by parenteral routes. Table 1 indicates the method of applying these principles practically.

As soon as possible, small oral feedings should be instituted. It is wise to wait until the seventh day for the administration of solid foods and small and frequent feedings are tolerated best until compensatory dilation of the esophagojejunal anastomosis takes place.

The operation of total gastrectomy is indicated for any growth which extends high on the lesser curvature, for massive tumors of the fundus, for growths involving the cardiac end of the stomach, and for cases of linitis plastica. This operation may be performed if there is enough mobility of the stomach and of the abdominal esophagus to do an esophagojejunostomy. It is not essential to perform a jejunojejunostomy nor to insert an enterostomy tube. The mortality rate for total gastrectomy ranges from 32 to 64 per cent as most of the patients are poor risks and the operation is technically difficult. However, the risk is justifiable in otherwise hopeless cases. Life may be prolonged even if the prognosis for permanent cure is not good. It has been stated that only 2 to 4 per cent of the total number of patients operated upon for gastric carcinoma will be alive at the end of five years. However, as the experience of total gastrectomy in-

creases and the technics improve so that the immediate mortality rates decrease, it is reasonably certain that the statistics for the complete five-year survival for cases of gastric carcinoma will improve. Although a patient's condition is improved only temporarily, it is certain that he will have a much more pleasant life and that the terminal state will be easier. It certainly justifies the application of radical resection to any patient who has a chance of cure, and also justifies the practice of removing all so-called benign tumors by wide dissection.

SUMMARY AND CONCLUSIONS

1. A report of a case of scirrhous carcinoma of the stomach of the linitis plastica type subjected to total gastrectomy is presented.

2. Total gastrectomy is justified, despite its high moratlity rate, for massive tumors of the fundus, growths extending high on the lesser curvature or involving the cardiac end of the stomach, and for linitis plastica.

3. Since total gastrectomy cannot always be anticipated prior to surgery, laparotomy for carcinoma of the stomach should be performed only by those surgeons qualified to do this formidable procedure.

4. The incision advocated for this procedure is transverse transecting both recti muscles and augmented by a left paramedian extension.

5. A Miller-Abbott tube in the efferent jejunal loop will alleviate postoperative ileus if such develops and obviates the necessity for jejunostomy. The proper time for insertion is during operation.

6. Splenectomy, if necessary for better exposure, does not add to the operative risk nor does it complicate the postoperative course.

7. Intratracheal anesthesia employing an inflatable cuff is the anesthetic procedure of choice.

8. The pre- and postoperative management is directed towards the attainment of an optimum state of nutrition. Particular

emphasis, postoperatively, should be placed on the administration of protein.

9. These patients are not necessarily limited permanently to frequent small feedings as compensatory esophagojejunal dilatation allows for eventual adequate capacity for food.*

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* Photographs were taken through the courtesy of the United States Army Signal Corps.

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To increase exposure, especially in the upper abdomen, a transverse incision may be made through the skin and anterior and posterior sheaths of the rectus muscle at right angles to a median incision. This type of exposure may be indicated in certain operations upon the gallbladder, stomach, pancreas, spleen, and transverse colon.

From "Operations of General Surgery" by Thomas G. Orr (W. B. Saunders Company).

MULTIPLE ARGENTAFFIN TUMORS (CARCINOIDS) OF THE RECTUM*

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ARGENTAFFIN tumors (carcinoids) occurring within the intestinal tract cannot be considered a rarity. Porter and Whelan[5] reported ten cases observed in 2,922 autopsies; Humphrey[4] found eight in 3,200 autopsies and Raiford[6] observed twenty-nine among 62,000 specimens including both autopsy material and those removed at operation.

Carcinoids may occur in any part of the intestinal tract; their distribution, however, is interesting. Argentaffin tumors are seen almost twice as frequent in the appendix as in the small intestine. Their occurrence in any other portion of the intestinal tract is rare.[5] Porter and Whelan cites cases in which this lesion occurred in the stomach, gallbladder, Meckel's diverticulum, cecum and in the colon.[5]

The rectum apparently is one of the least frequent sites in the entire gastrointestinal tract for carcinoids. In 1942, Stout found six cases reported in the literature and added six.[7] We have found only one case of a carcinoid tumor in the rectum reported since 1942.[8]

A case of multiple carcinoids in the rectum was recently observed at autopsy. It is reported firstly, since the previously reported cases had only a single tumor nodule, and secondly, because of the infrequency of carcinoids in the rectum.

CASE REPORT

The patient, a colored male, age sixty, was admitted to the hospital with the chief complaint of "shortness of breath." Death occurred approximately twenty-four hours later from a rupture of a dissecting aneuryam of the aorta. The significant lesion, from the standpoint of this paper occurred in the rectum. Innumerable nodules varying in size from a few millimeters to 1.0 cm., were present beneath the mucosa of the rectum. The nodules were relatively freely movable. They were rubbery in consistency and on cut section they were grayish-white. The entire rectum was so extensively involved by the tumors that it was impossible to touch the mucosa without also touching several tumors. The mucosa was normal and the wall of the rectum was not significantly increased in thickness by the presence of the tumors. (Fig. 1.)

The tumors were formed by varying sized groups of epithelial-like cells. Some of these cells were oval, while others were round. The arrangement of the tumor cells varied widely in the different nodules. (Figs. 2 and 3.) Sometimes these cells were in clusters and at other times the arrangement suggested a gland. Varying amounts of stroma separated the groups of tumor cells. The tumor nodules extended from the mucosa to the muscle. In some sections the neoplastic cells extended down into the muscle. Small granules were present in the cytoplasm of these tumor cells. After impregnation with an ammoniacal silver, some of these granules were black while others were yellowish-brown in color. (Fig. 3c.)

COMMENTS

This case of argentaffin tumors (carcinoids) of the rectum differs from those reported by Stout[7] in that the lesions are multiple while only a single nodule occurred in each of the previously reported cases. The location of the tumor nodules in the submucosa with extension into the muscle is frequently seen in this type of neoplasm. The cellular morphology and the staining reaction is consistent with tumors arising from the argentaffin cells in the glands of the intestinal tract.

Although there has been some contro-
versy between investigators as to. the
origin of this type of tumor, the concensus

mucosa. They may assume a pedunculated
form according to Raiford.[6] These tumors
usually are small, however, large ones
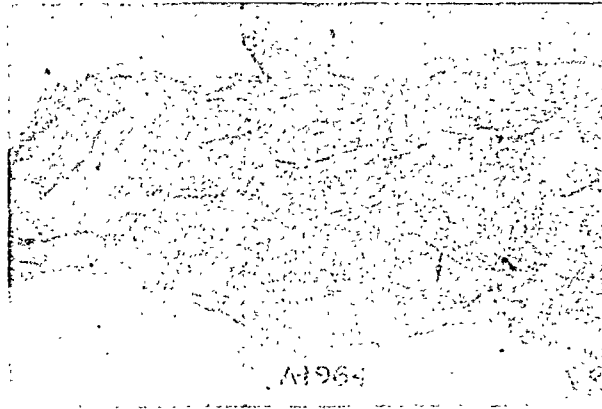
FIG. 1. Rectum with the anal margin to the right. The
individual tumor nodules are small and distributed
throughout the submucosa.

FIG. 2. There is some variation in the type of growth of the tumor cells in the
different nodules.

at this time is that they arise from the
argentaffin cells in the crypts of Lieber-
kühn. Ariel,[1] Forbus,[3] Porter and Whelan,[5]
Raiford[6] and Stout[7] have reviewed and dis-
cussed the histogenesis of carcinoids.

Multiplicity of carcinoid tumors is fre-
quent although this cannot be regarded as
typical of this type of neoplasm. These
tumors are usually small nodules in the
submucosa of the bowel. They are firm,
rubbery, and move freely beneath the

have been observed. The latter tumors may
be more difficult to move when they extend
down into the muscularis.

In Raiford's series of twenty-nine cases
of carcinoids all of those occurring in the
stomach and colon were malignant while
only one was malignant in the group of
seventeen from the appendix.[6] Cooke[2]
found twenty-one malignancies in 104
cases of carcinoid tumors of the small
intestine. There were two malignant car-

cinoids in the rectum in the group of twelve cases reported by Stout.[7] It is safe to say that argentaffin tumors are potentially

FIG. 3. The variation in the type of growth of the tumor cells is shown in A and B. The silver staining granules in the cytoplasm of the tumor cells are shown in C (ammoniacal silver preparation).

malignant, however, their grade of malignancy is usually quite low.[5]

Whenever an atypical tumor is found within the intestinal tract one should think of a carcinoid. Yaker says that "unless kept constantly in mind, the diagnosis is apt to be overlooked by both the clinician and pathologist."[8]

SUMMARY

A case of multiple argentaffin tumors (carcinoids) occurring in the rectum is reported from an autopsy case. The wall, for approximately 15 cm. was infiltrated with nodules varying in diameter from a few millimeters to 1.0 centimeter. The surface over these tumors was not ulcerated and there was no evidence of metastases. Apparently this is the fourteenth case of an argentaffin tumor occurring in the rectum to be reported, and the first case in which the nodules are multiplied.

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RECONSTRUCTION OF THUMB

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A CHINESE soldier was admitted to the hospital on August 10, 1944. He had sustained a severe shrapnel wound of the left hand about one month prior to entry.

Examination revealed complete loss of the left thumb including the entire metacarpal bone and the thenar eminence. By x-ray there was a healed fracture of the mid-shaft of the second metacarpal with lateral angulation of the fragments. Multiple small opaque foreign bodies were observed in the soft tissues. (Fig. 1.) An open wound on the lateral surface of the hand, measuring 8 cm. by 3.5 cm., was covered with fairly clean granulations. (Fig. 2.)

Because of the grotesque appearance presented by the loss of the thumb and thenar eminence, it was devised to reconstruct a new thumb. It was also hoped that some functional benefit would be derived from the operation.

At the first stage, on August 14, 1944, a tubed pedicle flap was fashioned from the tissues of the lower anterior chest wall. (Fig. 2.) A section of bone, about 7.5 cm. by 0.5 cm., was removed from the anterior surface of the left tibia and enclosed in the pedicle. The size and position of this bone is outlined in ink on the skin surface in Figure 2 and shown by x-ray in Figure 7. All incisions healed by first intention and at no time was there any drainage from the pedicle incision, or inflammation indicating foreign body reaction.

At the second stage, on September 8, 1944, the wound edges on the dorsum of the hand were excised. The inferior portion of the pedicle was elevated through a curved incision corresponding with the dorsal defect. The hand was then brought up to the chest and the two incision lines sutured with interrupted silk. A plaster jacket maintained the arm in position, a window being cut for dressings and removal of sutures.

It was decided not to detach the pedicle completely at a single stage although it is quite possible that this could have been accomplished. By using the two-step method an additional blood supply was ensured when complete severance of the pedicle was carried out.

The third stage was performed on September 24, 1944. The remainder of the wound edge on the palmar surface was excised, the division
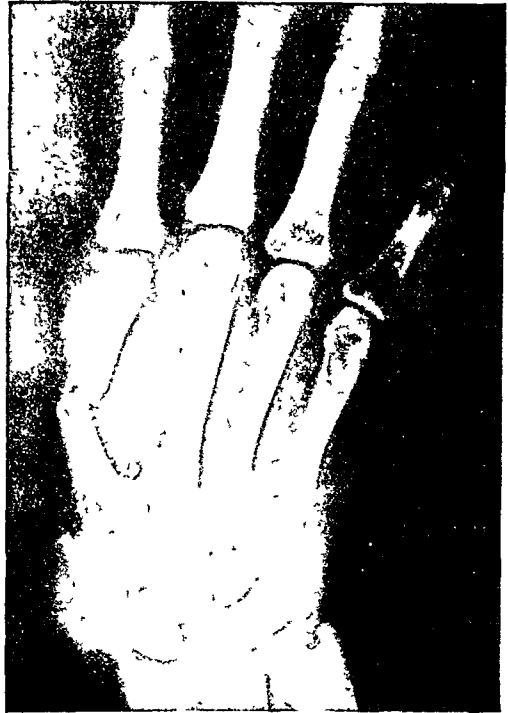
FIG. 1. X-ray of hand at the time of admission.

of the pedicle completed, and sutured into position to close the hand defect. (Fig. 4.) The arm was again immobilized in plaster with a window cut out to allow for dressings.

At the fourth stage, on October, 1944, after measuring the thumb on the right hand, the pedicle was divided at a point that allowed for similar length to the reconstructed thumb. The stump was closed with a long anterior and short posterior flap. (Figs. 5 and 6.) The unused portion of the pedicle was excised in the usual manner.

COMMENT

One modification in the above procedure might have been advisable. When the pedicle was divided for attachment to the hand, Thiersh grafting of the chest wall

FIG. 2.

FIG. 3.
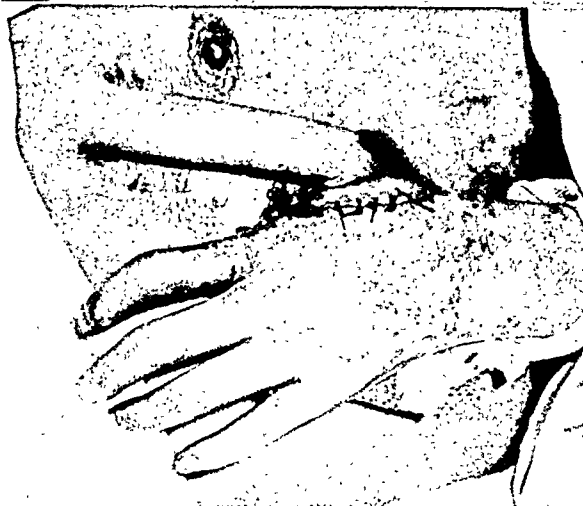
FIG. 2. Showing hand defect and pedicle, with size and position of bone transplant outlined on skin.
FIG. 3. The inferior portion of the pedicle has been raised and attached to the dorsum of the hand.

FIG. 4. Pedicle detached from chest wall and closure of hand defect now completed.

defect could have been done immediately, returning the flap to its original position. Then, when it was attached to the hand,

however, were noted: The reconstructed digit was firm with no tendency to be floppy. This was due to two factors: First,

FIG 5.   FIG 6.   FIG. 7.

FIGS 5 and 6 Reconstructed thumb after completion of operations

FIG 7 X-ray of hand showing bone transplant

no raw surface would have been present. Since the division of the pedicle was accomplished in two stages, this would have necessitated two additional operative steps. The drainage from the raw surface caused no problem in this case and final Thiersh grafting of this defect was carried out after reconstruction of the thumb had been completed.

The final cosmetic result would alone seem to justify this operation, which is essentially a simple procedure. It was possible to follow up this case for only a brief period so that claims for improved function of the hand must be guarded. Certain facts,

the presence of the transplanted bone in the shaft, and second, its broad attachment to the hand, allowing for a wide area of scar tissue formation.

The functional accomplishment in this case may be summed up by saying that the patient has been given a stiff thumb which has no motion but is present in a normal anatomical position, and against which the fingers may be opposed, thus allowing for a certain amount of grasping power.

The advisability of grafting the tibial transplant to the carpus was considered but the probability of its being easily fractured discouraged this idea.

OSTEOMYELITIS OF THE FRONTAL BONE AND SUBDURAL EMPYEMA WITH RECOVERY

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ALTHOUGH subdural empyema (abscess) secondary to suppurative frontal sinusitis has been recognized for fifty or· more years, the literature concerning this ominous complication is meager. In recent years Courville,[1] and Kubik and Adams[2] have made significant contributions to the study of this subject. Courville's paper includes an up-to-date review of the literature and a report of forty-two cases of subdural empyema secondary to suppurative frontal sinusitis verified at autopsy. Since recovery from subdural empyema is so infrequent it was deemed worthwhile to describe in detail the clinical course and mode of treatment in a successful case.

CASE REPORT

R. L. G., a white male, twenty-eight years old, a clerk in the United States Army, had always been in good health up to September 4, 1944, when he developed an acute upper respiratory infection. On September 8, 1944, he developed pain in the left frontal area extending over the left eye. Examination at that time was reported to show a swelling of the left frontal area and a purulent discharge from both nares. His temperature varied from 99° to 100.4°F. On September 12, 1944, he complained of headache and nausea and he vomited several times. He was treated in the Out-Patient Department with a nasal spray of cocaine and ephedrine. X-ray examination showed clouding of both frontal sinuses with sclerosis of the bone around the left frontal sinus. From September 17 to September 24, 1944, he received 20,000 units of penicillin every four hours. A culture of the nasal discharge at this time yielded Staphylococcus albus and hemolytic staphylococcus aureus. On September 28, 1944, an abscess of the left side of the forehead was incised and drained. He failed to improve and continued to complain of severe pain in the head and general malaise. On October 7, 1944, he was transferred by air from a United States Army Station Hospital in Canada to a General Hospital in the United States. Upon arrival he was drowsy and disoriented. There was a swelling of the scalp in the left frontal area. A few hours after admission a bilateral radical frontal sinusotomy was done. This disclosed osteomyelitis of the skull and an epidural abscess; 25,000 units of penicillin were given on admission and continued every three hours. On October 8, 1944, a right-sided hyperreflexia was noted. The patient seemed to ignore the right side of his body. He pointed correctly to a few parts on the left side of his body but was unable to point to any part on the right side. He had a marked expressive aphasia. A lumbar puncture showed a pressure of 390 mm. of water. At 2 P.M. on October 8, 1944, he had a Jacksonian seizure which began on the right side of the face and spread to the right upper and lower extremities. The patient was considered "too sick to move by air or rail" at this time. He was given 5 Gm. of sodium sulfadiazine intravenously. The patient's temperature was 103.6°F.

The patient was transferred to another General Hospital by air on October 9, 1944, and came under the author's observation at 6:30 P.M. on that day. On examination the patient appeared critically ill. He was in deep stupor but moved about slightly on painful stimulation. There was slight neck rigidity and a bilaterally positive Kernig. Both optic discs showed slight blurring. There was a right hemiplegia with a positive right Babinski sign. X-ray examination of the skull showed a moth eaten appearing area of bone destruction about 3 by 3 cm. in the left frontal area. A lumbar puncture showed a pressure of 230 mm. of water. The fluid was clear but contained 215 cells per cubic mm., 67 per cent were polymorphonuclears and 23 per cent were lymphocytes. Culture showed no growth (later report). Blood count was: red blood cells 2,750,000; white blood cells 16,000, 88 per cent polymorphonuclears and 12 per cent lymphocytes; temperature was 101.8°F.; pulse 88; blood pressure 156/70.

Operation was begun at 10:50 P.M. October 9th and lasted to 12:40 A.M. October 10, 1944. With the use of local anesthesia the incision of the previous bifrontal radical sinusotomy was reopened and extended laterally to the left. A new incision was made beginning at the glabella and extending in the sagittal plane to about 3 cm. beyond the hair line and then laterally to the left temporal region. (Fig. 1.) Michel clips were applied to the wound edges and these were left in place for three days to control bleeding. The scalp flap including the periosteum was stripped from the bone. The outer table of the skull appeared roughened and of increased vascularity in the left frontal area, corresponding to the area of bone destruction noted in the x-ray film. An opening was made in the skull with perforator and burr. Pus was present in the diploic spaces. All the diseased tissue was removed with rongeurs well out into normal appearing bone. A few granulations were present on the dura. After preparing a small area with iodine and alcohol the dura was punctured with a fine needle. Pus was obtained from the subdural space. The dura was then opened widely in all directions. A large amount of pus escaped and was removed by suction. The pus extended laterally to the temporal region and posteriorly to the parietal region. Rubber tissue drains were inserted into these areas and along each a Dakin tube was placed so that penicillin could be instilled locally without disturbing the dressing. Gauze packs saturated in a solution of penicillin containing 500 units per cc. were placed on the dura. The scalp flap was then loosely sutured in place with a few silkworm gut sutures. The wound was then sealed. The patient was turned over and re-draped to expose the left occipital area. The skull was opened and even though the dura appeared normal a rubber tissue drain was placed in the subdural space. This was done because of the author's experience with previous unsuccessful cases of ·subdural empyema in which autopsy showed loculation of pus in the occipital region. A transfusion of 500 cc. of whole blood was given during the operation.

The patient seemed more alert following the operation. He had two right-sided Jacksonian seizures the following morning. Nasal oxygen and penicillin 20,000 units every three hours were started on return to the ward. He began to move his right arm on the morning following operation. Transfusions, each of 500 cc. of whole blood, were given on October 10th and October 11th. The patient's favorable course is best pictured by the temperature chart. (Fig.

Fig. 1. Appearance of wound one week after operation.

2.) On October 15th the patient was alert and was able to talk in single words. Beginning immediately after operation 30 cc. of penicillin (500 units per cc.) were injected into the wound twice a day by means of the Dakin tubes. The wound was dressed on the third postoperative day and the Michel clips removed from the scalp edges. On October 16, 1944, one week following operation the second dressing was done. The wound was clean and free of pus at this time. The patient's improvement was rapid. On November 6, 1944, under intravenous sodium pentothal anesthesia a secondary closure was done. The author was transferred to overseas duty at that time. Follow-up was maintained by mail. The patient's letters showed no evidence of any language defect. A letter received in October, 1945, one year following surgery, stated that a tantalum cranioplasty had been done and that the patient considered himself to be in normal health.

COMMENT

In the author's previous experience with cases of subdural empyema he had never obtained a cure. The method of treatment was in every major respect similar to that used in the present case with one important

exception. This was the first case in which penicillin was used. However, the favorable result cannot be attributed solely to the empyema secondary to frontal sinus infection has been adequately described by Courville and Kubik and Adams so that
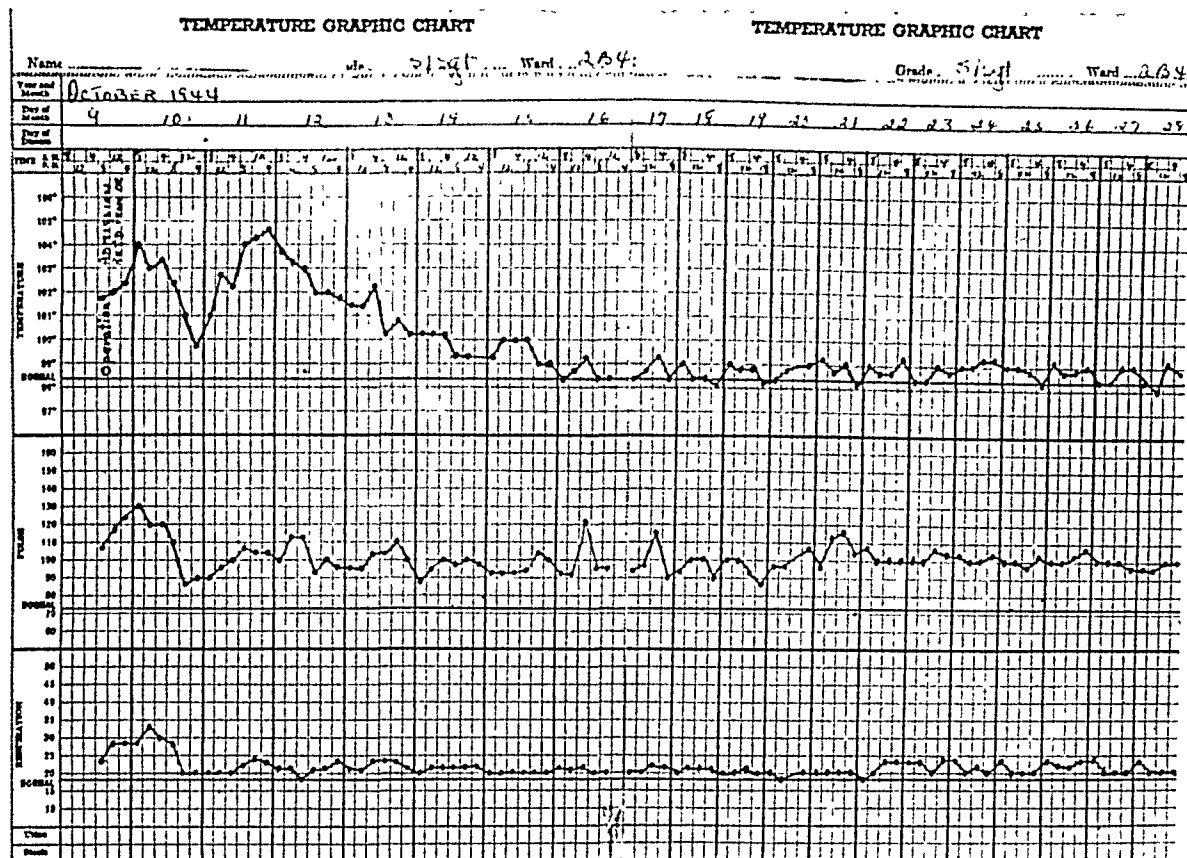
FIG. 2. Temperature graph.

use of penicillin since the patient was adequately treated with this agent prior to surgery without any influence on his progressive downhill course. At the time of operation he was almost moribund, much worse than any case of subdural empyema which had previously come under the author's care. He recovered promptly following adequate surgery combined with systemic and local penicillin and transfusions.

It was fortunate that the organism responsible for the infection was extremely susceptible to penicillin. The laboratory reported the organism to be "a streptococcus viridans more susceptible to penicillin than the standard staphylococcus hemolyticus strain."

The clinical course in cases of subdural only the salient features will be reviewed. During an attack of acute frontal sinusitis or an acute exacerbation of chronic frontal sinusitis, the first sign of spread of infection to the subdural space may be a Jacksonian seizure on the contralateral side. After the initial seizure the course may be fulminating with headache, signs of focal involvement, such as hemiplegia and aphasia, then stupor and signs of systemic toxemia. Evidence of meningeal irritation is usually slight or absent and the spinal fluid only shows signs of mild irritation resulting from the contiguous infectious processes. If, in addition to the subdural empyema there is also a diffuse osteomyelitis of the skull, the scalp over the involved bone exhibits a typical doughy swelling.

The spread of infection from the frontal sinus to the subdural space has been adequately discussed by Courville. He believes that direct extension through an area of erosion in the posterior sinus wall to be rare and favors the pathway of the communicating veins as the most common route.

Treatment. Subdural empyema is a surgical lesion. Once the diagnosis is made exploration and drainage should be carried out without delay. The opening in the skull should be large enough to provide adequate drainage. Primary closure of the scalp flap is never justified. The surgeon should not be concerned with the size of the bony defect. Cranioplasty at a later date is far preferable than to risk inadequate drainage. In addition to surgery systemic and local penicillin in full dosage is indicated.

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Necrosis of bone is due to periostitis, osteitis, osteomyelitis, irradiation or injury. *Toxic necrosis* is caused by phosphorus or mercury, often in association with bacteria. *Senile necrosis (quiet necrosis)* follows traumatism, probably with a mild associated infection.

From "Principles and Practice of Surgery" by W. Wayne Babcock (Lea & Febiger).

HYPERPARATHYROIDISM DUE TO PARATHYROID ADENOMA

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THE following is a presentation of a very atypical case of hyperparathyroidism due to parathyroid adenoma, bringing out the difficulties of diagnosis, and also a review of the literature to present the difficulties encountered in the surgical removal of these adenomas.

CASE REPORT

CASE 1. No. 8685. A white female, age forty-four, was admitted to the hospital on September 17, 1936, with the following complaints: nausea and vomiting, frequency of urination and occasional sharp pain in the bladder like a knife sticking, a history of continuous dull ache in the right kidney region when walking a great deal for the past two years, and some weakness. Urinalysis revealed: albumin positive, specific gravity 1014, blood normal, few leucocytes and occasional hyaline cast. X-rays revealed the following: both kidneys appeared studded throughout with minute calcium deposits. The pelves were filled out and appeared normal; they were cleared of all symptoms in five days under routine urinary antiseptics. Skin tests, sputum, and x-ray of chest were all negative for tuberculosis. Blood calcium and phosphorus were normal.

On June 24, 1937, the patient was readmitted to the hospital complaining of nausea and vomiting and urinary frequency. Urinary findings were essentially the same as before. A complete gastrointestinal series did not reveal any pathological condition. Pelvic bones and x-ray of the skull did not show decalcification. An x-ray of the chest was normal. Blood calcium at this time was 14 mg. per 100 cc. of blood, and blood phosphorus was 2.5 mg. per 100 cc. of blood. Organic phosphatase was .15 mg. per cc. of blood. Under routine measures the urinary disturbance improved.

The patient, however, kept complaining of weakness and occasional vomiting spells. She lost weight and seemed to get progressively worse until six months later while walking she fell and broke both femurs. X-ray at this time revealed a definite decalcification and cystic formation throughout both femurs and also in the skull. Blood calcium at this time was 15.7 and the blood phosphate was 3 mg.; phosphatase (Bodinsky method) was 28 units. A diagnosis of parathyroid tumor was made but the patient's condition did not warrant any exploration at this time. Supportive splints and deep x-ray treatments were given over the parathyroid regions as a temporary measure, but with no apparent results. The blood calcium and urinary calcium kept on a continual rise although the blood phosphorus stayed about the same. After about two months of transfusions and other supportive measures the patient seemed to be in condition to explore the parathyroids.

The thyroid was exposed in the usual way by the collar thyroidectomy incision. The pretracheal fascia was opened in the midline. The strap muscles were divided high up on both sides between muscle clamps and reflected. The right side was first dissected by rotating the thyroid mesially and exploring the region at the bifurcation of the inferior thyroid artery. Here, as well as at the upper pole and lying rather deep, two normal sized parathyroid glands were found and left in place. No parathyroid tissue was located at the lower pole. The inferior pole vessels were divided, the fascia overlying the gland posteriorly incised and the dissection carried downward into the upper borders of the mediastinum. No tumor was found here, so the same procedure was carried out on the left. Here, however, on deep palpation and lying about 5 cm. below the inferior pole a tumor mass was felt. It was rather easily enucleated and delivered into the operative field. Its vascular attachment was clamped and tied and the tumor removed. It appeared as a firm, grayish-brown, encapsulated mass. Routine thyroidectomy closure was used without drainage.

There was little reaction from the operation and within three days the patient was on a

general diet and seemed to feel somewhat improved. One week following the operation the blood calcium was 6.5 mg. and the blood phosphates 2.6 mg. Blood phosphatase was 10.18 Bodinsky units. She was extremely nervous and apprehensive. Chevostek's and Trousseau's signs were negative. Heavy doses of calcium gluconate and parathormone were administered and during the next few days the patient was much less restless and the blood calcium rose gradually daily until a level of 11 mg. was reached. Blood phosphates rose to 5.5 mg. and remained there.

The fractures, up to the time of operation on the parathyroid, showed no attempt at uniting and there was absolutely no calcium deposit at the seat of fracture. After the operation the fractured areas became gradually more stable, and each month showed more and more callous formation. This process, however, was extremely slow and during the first month following the operation she broke her left clavicle and also the right humerus just by trying to turn herself in bed. It was eighteen months before we attained enough callous union and recovery in the long bones in general to permit the patient to try to walk on crutches.

Two years after operation the patient was readmitted to the hospital for a check up. She was now able to walk quite well on crutches. Blood calcium was 10.5 mg.; blood phosphates were 3.7 mg. She was complaining of a frequency and back ache. The urine contained many pus cells and a few red blood cells. X-ray of the kidneys showed the same diffuse calcification as the previous x-ray before operation. No isolated calculi were found and the patient improved on routine urinary antiseptics. Electrocardiogram at this time showed no myocardial changes.

Four years after operation the patient was readmitted to the hospital with urinary disturbances. The blood picture was normal in every detail. Urinalysis showed many blood cells and clumps of pus cells and a few granular casts. X-ray of kidneys was again the same as before. She responded to treatment but much slower than the previous admission.

Another year passed and she was readmitted to the hospital and presented the picture of a chronic nephritis. Blood urea and urea nitrogen were both elevated, with blood, pus, and casts in the urine. From this she never recovered. She lingered on for another year with periods of

remission or improvement. Her blood pressure constantly rose and she gradually showed more and more signs of myocardial failure, and died presenting the picture of cardiorenal disease.

SUMMARY AND COMMENTS

Diagnosis is the most difficult procedure in this affliction when you are confronted with such atypical symptoms and findings. A typical case would naturally have the increase in the blood calcium and the drop in the blood phosphorus and phosphatase. At the same time you should find the bony changes of osteitis fibrosa cystica and the calcinosis of the kidneys with the accompanying urinary findings. Along with this you might have a few of the other systemic findings as loss of weight, impaired appetite, constipation, indigestion, nausea and vomiting, and even pes planus due to muscular weakness.

Many of these cases first present themselves as renal calculi. This case first presented itself with the typical calcium deposits throughout both kidneys of hyperparathyroidism and a resultant urinary finding of pus and blood. The blood calcium remained normal and there were no bony changes for several years. Later she displayed both the bony changes and the increase in the blood calcium but the blood phosphorus always remained rather normal. A very striking thing about the case was the sudden onset of bony changes with the rise in blood calcium. Due to the urinary findings and the kidney x-ray findings for such a long period of time without any other changes we were suspicious of tubercular changes. Skin tests and sputum analysis and chest x-ray all disproved this theory. I am now of the opinion that when such typical findings in the kidneys are manifested and the other possibilities ruled out that one is justified to explore the parathyroid region for a tumor and not wait for all the other findings and symptoms.

A review of the literature on the subject brings to light many surgical difficulties. One of them is that although you find a

tumor on one side in the parathyroids you should be sure to explore the opposite side for another tumor, which happens quite frequently. Most of them seem to have been found in the upper substernal region but some have been reported posterior to the trachea, at the upper pole of the thyroid, inside the thyroid gland itself, and also at the bifurcation of the inferior thyroid artery. A few cases were reported where the tumor was never found, not even at autopsy. These must undoubtedly be cases in which there is congenitally misplaced parathyroid tissue, such as is found with endometrial tissue as in endometriosis, or a hidden dermoid cyst.

The differential diagnosis relies mainly upon the blood chemistry and x-ray. X-ray findings might be confused with Paget's disease or osteitis deformans, but the blood chemistry would differentiate the two. The estimation of the hormone quoted in Bodinsky units will range from 12 to 20 in hypercalcemia of hyperparathyroidism, but will be much higher in Paget's disease. In other bony tumors you do not have the hypercalcemia. Rickets is a disease of infants, whereas hyperparathyroidism usually appears between twenty to forty years of age.

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(Bo.B.) = Bookshelf Browsing; (E). = Editorial

(Fig. 5A and B.) Other characteristics of this condition are that the margins of the bone at the site of fracture appear hazy of the periosteum along the edge of the metatarsal do not show fracture lines. Great care must be taken on wet readings

FIG. 3. Beginning heavy callus formation of the middle third of the right second metatarsal bone.

FIG. 4. Oblique fracture of the middle third of the third right metatarsal bone.

and indistinct. (Fig. 6A and B.) No changes are seen in the medulla in early cases. Many of the cases with slight thickening to detect the fine incomplete oblique fracture lines. At times, the fracture lines are seen only on dry plates. (Fig. 7.)

TREATMENT

The treatment we have been following is essentially that as described in our previous article.[1] It consists of a steel bar one-half of an inch to five-eights of an inch wide, one-eighth of an inch thick, and six inches long being countersunk in the slip sole of the shoe. The only change we have made is that instead of using four rivets to hold the bar in place we now only use one rivet and several tacks. (Fig. 8.)

COMMENT

1. As the rigors of training increased following the fifth week of the training cycle, an increase in number of march fractures was noted. This increase in march fractures continues through the sixth, seventh, eighth, ninth, and tenth weeks of training. The soldier gradually became toughened to this unusual hardship, and feet which had not previously been accustomed to marching were toughened to the extent that few march fractures were noted in the latter part of their training.

2. The ambulatory treatment of metatarsal march fractures by means of march bar has shown a tremendous unprecedented saving in soldier training hours.

3. A close follow-up has shown that none of the patients thus treated has

2. These patients were all treated by use of the steel bar countersunk in the slip sole of the shoe.

FIG. 7. Early incomplete oblique march fracture through distal third of the second right metatarsal bone.

3. Fifty-eight cases did not respond to the usual treatment; of this number
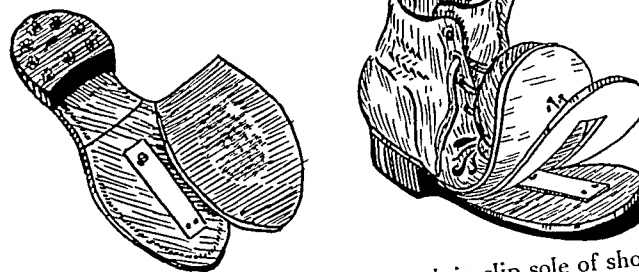
FIG. 8. Showing steel bar countersunk in slip sole of shoe.

suffered any undue personal hardships, nor have there been any unfavorable complications. The end result, in each case, has been excellent.

thirteen were hospitalized and forty-five excused from certain portions of their training cycle. These fifty-eight trainees eventually finished training and were qualified for overseas. One man received a medical discharge. This was for an injured right knee and not for his march fracture.

SUMMARY

1. Six hundred and ninety two cases are reported with 724 march fractures.

FIG. 6A.

FIG. 6B.

FIG. 6. A, fracture of the distal third of the fourth left metatarsal bone, showing hazy indistinct margins. B, fracture of the distal third of the fourth left metatarsal bone, showing early callus formation one month later. Same case shown in Figure 6A.

PSYCHOSOMATIC SYMPTOMS AND BORDERLINE HYPERTHYROIDISM

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THE surgeon of yesteryear little realized that posterity would demand a psychiatric knowledge in modern surgery. In the diagnosis and care of hyperthyroid patients the surgeon trespasses on the confines of the psychiatrist. Although he does not enter his domain, it cannot be denied that in the care of the borderline hyperthyroid patient the surgeon pierces the outskirts of this realm.

Psychosomatic medicine concerns itself with those patients who are neither physically ill nor have an organic mental derangement. These patients are categorized as having "functional illnesses." Most of these patients have a nervous disposition. A tremor may be present with palpitation occasionally noted. This triad of symptoms labels the patient a hyperthyroid. A basal metabolic rate is taken on the nervous patient. It is usually elevated. Failure to repeat this study does not reveal the error. The diagnosis is apparently correct and the patient is sent to the surgeon for thyroid surgery.

The surgeon now assumes the responsibility. Unless he is alert he will perform a subtotal thyroidectomy on a patient whose symptoms will persist or become more marked following surgical intervention.

Neurocirculatory asthenia is the most common disorder confused with hyperthyroidism. These individuals have palpitation, tachycardia, tremor, weight loss and a slightly elevated basal metabolism. Such patients, however, have no eye signs, no increase in pulse pressure or pulse rate, poor appetite, cold extremities and they demonstrate no manifestations of chronic anxiety.

Psychoneurotic states produced by psychic trauma simulate hyperthyroidism.

A patient may have witnessed or was a party to a frightening experience. This factor may precipitate symptoms closely paralleling toxic goiter. This class of patients perhaps have a pre-existing hyperadrenalism. The physical examination of such persons may not confirm the history of tremor, sweating and tachycardia. The gland may be normal to inspection and palpation without any audible bruit. The value of the pulse rate which is increased in hyperthyroidism, is noteworthy. Psychic factors may cause a temporary elevation whereas hyperthyroidism maintains a constant elevation of the pulse rate. A fact to remember is that the toxic goiter patient is usually older than the neurotic individual. We have observed that patients with true hyperthyroidism have a tendency to cry spontaneously without apparent cause.

When the basal metabolism has been elevated on the initial reading, technical inaccuracies may be the cause. The nervous individual should be informed of the procedure and his cooperation obtained. As a generality it may be stated that cooperation and relaxation are less frequently obtained with psychoneurotic patients than with hyperthyroids. Repetition of the test each morning until a satisfactory technical reading is obtained may reward the observer with a normal basal metabolic recording.

Another important differentiating observation is the apparent improvement when these functionally disturbed patients are hospitalized. When these persons are liberated from familial entanglements relief occurs within a few days. Freedom from noxious mental stimuli eradicates the tachycardia and nervous symptoms.

4. Two hundred thirteen thousand and twenty-four training hours were saved during fourteen months using the march bar treatment.

5. Our series shows that most of the fractures occurred when the training cycle was stepped up in the fifth and sixth weeks of training.

6. March fracture occurred more often in the right foot than the left. Any one of the metatarsal bones may be involved and one soldier can have two or three march fractures at the same time.

7. The relative lengths of the first, third, and fourth metatarsal bones were measured in 692 cases of march fracture; the second metatarsal being used as a base and given the value of zero. The metatarsals of 100 normal feet were measured, and these measurements compared with the march fractured feet. There was no conclusive evidence of a relatively shortened first metatarsal playing a part in the etiological factor, of march fractures.

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USE OF A DOUBLE ROLL AS A BANDAGE

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ROUND or irregularly curved surfaces of the human body present considerable difficulties in the application of

Head Dressing. The rolls are applied with the knot in the occipital region and brought forward, then they are crossed;
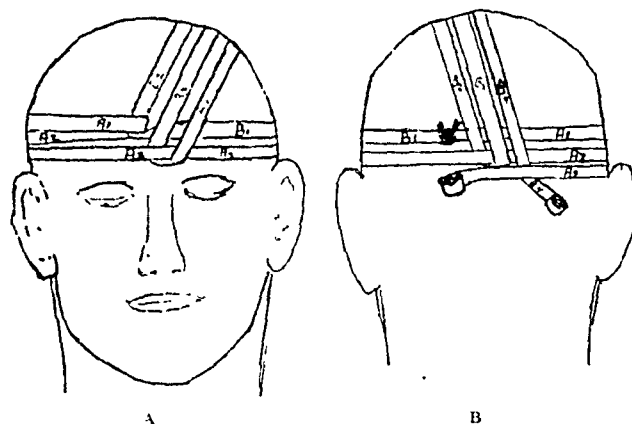
FIG. 1.
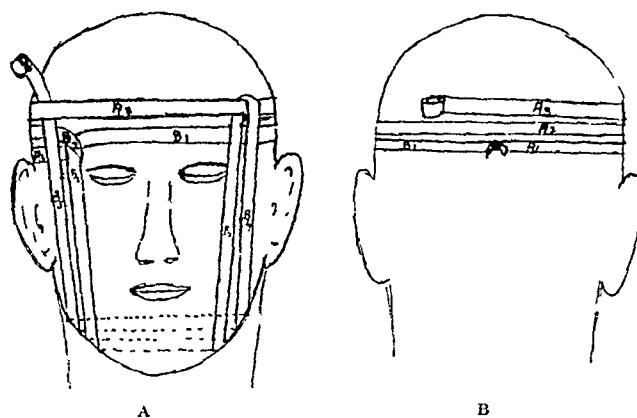
FIG. 2.

bandages by the usual methods. The use of only one bandage, to cite an example, will not hold securely a dressing for the scalp. The loops carried over the prominent portion of the part to be bandaged have a tendency to loosen unless they can be securely anchored. This disadvantage can be overcome by using two individual rolls of the same size tied together at one end: One roll serves as the base to which the other roll finds a secure attachment.

roll A at 180 degrees, wound in the opposite direction; roll B at 45 to 90 degrees, carried over the vertex to the occipital area where it is crossed by roll A. Then roll A is wound around the head in a horizontal position without changing its direction, thus serving as a base for each crossing of roll B. (Fig. 1A and B.)

In this way any area of the skull can be covered with a minimum of bandage and a maximum of fixation. The pressure ex-

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When persons with mental unrest have been convinced of the functional nature of their complaints and are assisted by competent helpful psychiatric suggestions, improvement is noted. With the aid of a psychiatrist the so-called hyperthyroid patient undergoes a complete metamorphosis. All patients suspected of mild hyperthyroidism do not fall into the category stressed, even as the diagnosis between a functional disorder and borderline hyperthyroidism is not as facile as outlined above. Each individual is a singular problem. There is no one diagnostic pattern applicable to all patients.

Caution is advised against the other extreme of failing to recognize a true borderline hyperthyroid patient. To brand such a patient a hypochondriac, a malingerer or a neurotic may produce deleterious results. It must also be realized that hyperthyroidism is a constitutional disease and as such may display unusual psychic reactions. Although no characteristic psychic reaction is indigenous of hyperthyroidism, many of these patients have acute delirium. Some patients with long standing hyperthyroidism may manifest toxic exhaustion psychosis and others a manic depressive reaction.

True mental disease may occur in the hyperthyroid individual as in others. In such instances it is difficult to sift the mental class of symptoms from the hyperthyroid group. This type of patient, however, presents many signs of hyperthyroidism which categorize the disease. Thus even if the mental complaints are attributed to hyperthyroidism, at least the major underlying pathological condition has been identified.

Upon the thyroid surgeon rests the burden of separating borderline hyperthyroidism from functional disorders. His perspicuity and decision will save the neurotic from a needless thyroidectomy, even as he can eradicate hypochondriasis from a patient with mild hyperthyroidism.

FIG. 1. Lewin's method of treating fracture of the clavicle in young children, illustrating the method of obtaining backward displacement of the shoulders by means of a metal or wood bar. While the bar is in place, a figure-of-eight double spica is applied. This allows free motion of the arms. For a day or two it is advisable to apply a sling. In this method of treatment a plaster of Paris double spica may be used.

erted on a wound is far greater than by application of the routine head dressing.

The same principle can be used in apply-

FIG. 3.

FIG. 4.

FIG. 5.

ing dressings to the chin as a support for a fractured mandible or wounds of the lateral portions of the face. The rolls are again applied with the knot in the occipital area and then crossed over in the right temporal region. Roll B is carried downward, across under the chin, upward, and in the left temporal region crossed over roll A, which was reversed in its original direction. Roll A is wound from left to right anteriorly and crossed on each temporal

region by roll B. (Fig. 2A and B.) This is done five to seven times, then roll B is carried from the right temporal region behind the right ear in a diagonal direction appearing in front below the left ear, then carried forward to cover the chin, roll A is used in the same way, starting in the left temporal region. Roll A and B cross each other on the chin, occiput and forehead.

Shoulder Dressing. Rolls are applied with the knot in the back, two to four inches below the scapula and brought forward. After crossing roll B, roll A is reversed in its direction. Roll B is carried over the

shoulder down the back and after being crossed by roll A is brought back to the original starting point. (Fig. 3A and B.)

Dressing of Inguinal Wounds. The rolls are applied with the knot at the level of the second to third lumbar vertebra and brought forward. Roll A is reversed in its direction in the left lower abdominal quadrant. Roll B is carried down to the inner aspect of the thigh. Thence in a horizontal direction to the area below the greater trochanter, from there slanting upward to the left lower abdominal quadrant. Here roll A, running from left to right anteriorly, serves as a base for roll B. (Fig. 4A and B.)

The contour of an amputation stump presents the same problem as a head dressing. Therefore, the same procedure will be followed. (Fig. 5A and B.)

BLEEDING from wounds of the palm of the hand is often profuse, for not only is the blood supply generally a rich one, but is derived from several sources. With a mass of important structures in the immediate vicinity it is inadvisable to apply artery forceps blindly; nevertheless, bleeding here should be treated by local haemostasis, and not by ligature of the proximal vessels, i.e. radial and ulnar, except as a last resort.

From "Minor Surgery" edited by Humphry Rolleston and Alan Moncrieff (Philosophical Library).

FRACTURE OF THE CLAVICLE

A SIMPLE METHOD BY MEANS OF WHICH THE PATIENT HOLDS HIS OWN SHOULDERS BACKWARD AND UPWARD*

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THERE is a large number of methods of treating simple fractures of the clavicle. About twenty years ago at St. Luke's Hospital, Chicago, while treating a six-year-old boy who had fractured his clavicle, I placed him on a chair and pulled his shoulders back by pulling his elbows behind him. Then I placed an ordinary wand across his back but in front of his flexed elbows. This automatically maintained his shoulders in proper position while I applied a figure of 8 retention bandage. At present, I apply a plaster of paris yoke cast.

A wand, section of broom handle, a bar, cylinder or rod may be used. This technic releases one or two assistants.

* The author's first description and illustration of this method appeared in his book, "Orthopedic Surgery for Nurses," published by W. B. Saunders Company.

result is not a fused parenchymatous mass, but two entirely separate structures, each within its own capsule, sometimes lying

About one year previously (1943), she developed back pain. This pain was always on the right side, radiating from the lumbar area

FIG. 1. Retrograde pyelography, showing normal renal pelvis and calyces. Also shows partially emptied supernumerary kidney to the medial side of normal kidney.

FIG. 2. Shows retrograde filling of the accessory ureter and supernumerary kidney. Marked constriction of the ureter near Mackenrodt's ligament.

in apposition, with or without loose connective tissue attachment or vascular or ureteral anastomosis.

CASE REPORT

L. P., a twenty-four year old white married woman, of Italian extraction, presented herself at the office of the senior author (D. M. H.) November 11, 1944, complaining of dribbling from the vagina and desirous of becoming pregnant.

As far back as the patient could remember, there had been a constant leakage of urine from the vagina, both nocturnal and diurnal, necessitating the wearing of a vulvar pad. She had been married three years, but had never been pregnant. She had been given office treatment by other physicians for many years, but her discharge had never been relieved.

anteriorly into the right groin and pubic area. Pain was worse at the time of menstruation and upon arising in the morning. It was dull and aching in character, and never had been colicky. There was no polydypsia and no pruritis vulva.

Previously the patient had always enjoyed good health. As a child she had measles, varicella and pertussis. She had an appendectomy performed in 1939, but no mention of kidneys made at this time. She was employed as a seamstress. The genitourinary examination was negative. The menstrual history was normal and there had been no accidents or injuries.

The general physical examination showed a well developed, well nourished woman with negative physical findings except in the vaginal examination. There was tenderness over the right kidney area posteriorly. Neither kidney was palpable.

Case Reports

SUPERNUMERARY KIDNEY WITH URETER OPENING INTO VAGINA

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A SUPERNUMERARY kidney is one of the rarest of renal anomalies.[1] Geisinger[2] reviewed the literature in 1939 and reported thirty-eight cases of authentic supernumerary kidney. He added two cases of his own. Since then, three more cases have been added,[3] bringing the total to forty-three. In this series, five cases have been reported with extravesical ureteral openings.[4,5,6,7,8] Only one of these was diagnosed preoperatively. This case is reported to bring the literature up to date.

Geisinger[2] states that a true supernumerary kidney is a distinct encapsulated, large or small, parenchymatous mass, topographically related to the usual kidney by a loose cellular attachment at most and often by no attachment whatsoever. Many cases reported in the past are double or fused kidneys, and not true supernumerary kidneys.

A brief review of the embryology of the kidney and ureter will explain in a measure how the anomalies of the upper and lower urinary tract may arise.

Embryology. For practical purposes, the pronephros and mesonephros may be disregarded. These exist during early stages of growth of the embryo, successfully performing some degree of excretory function and then degenerating upon the appearance and full development of the metanephros from which the permanent organs are elaborated.

From the caudal segment of the primordial excretory (Wolffian) duct, a hollow hemispherical bulb develops and begins to grow; at first, dorsally and then cranially, consisting now of a short pedicle (the ureter), with a mushroom shaped extremity —the future pelvis. Further growth is concerned with an elongation of the ureter and expansion of the pelvis with subsequent division into calyces, papillary ducts and collecting tubules. Co-incidentally, a parenchymatous mass is assuming form. This arises from a separate anlage, the mesochyme or renoblast. The latter accompanies the ureter in its ascent, covers the primative pelvis like a cap, and eventually produces the secretory glandular portion of the organ. Union of the two segments occurs and there finally issues therefrom the complete normal urinary system with kidney and ureter in their accustomed anatomical position.

Numerous deviations from this characteristic behavior of the ureteric bud and associated renoblast are possible and actually occur with varying frequency.

Instead of embracing the prematurely divided ureteric bud as a common cap, the mesochyme may also divide and each ureter or each limb of a bifuracted ureter may possess an independent mass of metanephrogenic kidney. In the course of subsequent development and ascent, the two renoblasts follow a parallel but separate course, sometimes equal as to ultimate rate course, sometimes equal as to ultimate size and function, but as a rule with marked disparity between the two, either because of unequal division of the mesenchyme or definiciency in the blood supply of the one as compared with that of the other. In either event, however, the final

bladder to the place where it was removed intra-abdominally. The ureter was then pulled out and the wound closed with a running

The patient was discharged on the twenty-second postoperative day. Abdominal and vaginal incisions were well healed. Follow up
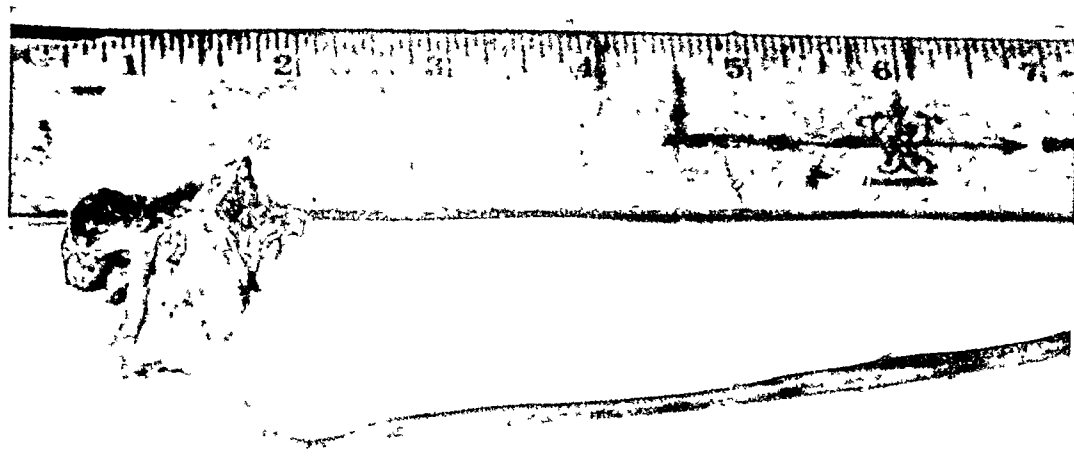
Fig. 4. Actual photograph of specimen after incising and laying open pelvis and kidney.

chromic No. 1 suture. The patient left the table in good condition.

Preoperative diagnosis: Extra kidney, right side; congenital extra ureter, opening into vagina.

Postoperative diagnosis: Same.

Nephrectomy and complete ureterectomy had been performed.

The ureter opened into the vagina and said ureter was attached to a very small kidney, which was to the medial side of the right normal kidney. This kidney was not attached to the larger normal kidney by any renal tissue. There was a separate blood supply together with a separate ureter.

Pathological report: Rudimentary kidney and ureter. (Figs. 3 and 4.) Kidney $1\frac{1}{2}$ inches by $\frac{3}{4}$ inches, firm in consistency, pole in ureter $13\frac{3}{4}$ inches, connected with the pelvis of the kidney. Ureter: Composed of fibrous tissue with a lining layer of epithelial cells. The sections consist of rudimentary kidney and a section of ureter. Kidney: First a thick fibrous capsule, beneath this is a layer showing tubules. Some of the tubules are lined with normal cells. The rest show rudimentary formation. An occasional functioning glomerulus is seen. Beneath this is a small pelvis. Below the pelvis is a dense fibrous mass in which there are a few sections of normal ureter. Diagnosis: Rudimentary kidney and ureter.

examination on May 11th, revealed the abdominal scar to be firm; there was no tenderness, and no evidence of hernia. The patient stated that for the first time in years she was free from the continual dripping of fluid of the vagina.

COMMENTS

1. A case of true supernumerary kidney with extravesical opening of the ureter is reported.

2. The question of whether or not the continual passage of urine into the vagina with subsequent stagnation and alkalinization was the etiological factor in the patient's sterility, must await the return of her husband from the Armed Service.

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Vaginal examination revealed a normal vulva. The vagina was found to be full of clear-like fluid, alkaline in reaction. She had a nulliparous cervix. The uterus was in mid-

The retrograde study (Fig. 1), of the (normal) right ureter and kidney showed no abnormal change in the ureter, while the renal pelvis and calyces appeared normal.
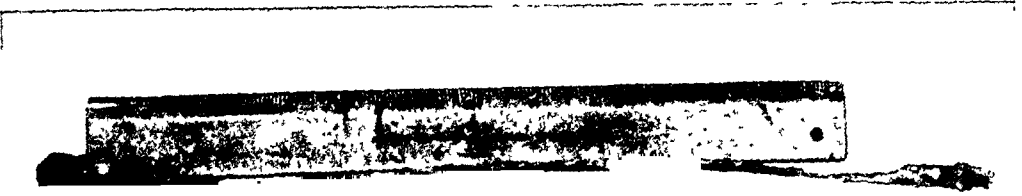
FIG. 3. Actual photograph showing specimen after removal.

position, freely movable and normal in size. There were no adnexal tenderness or masses palpable. More careful examination disclosed a small orifice, 2 cm. to the right and 1 cm. below the external urinary meatus. Through this orifice, a colorless fluid was being discharged at periodic intervals, very similar to the discharge from the normal ureter. Provisional diagnosis: Anomalous ureteral opening into the vagina.

Laboratory examination of the urine showed alkaline reaction; specific gravity, 1.015; albumin, 1 plus; negative for sugar; 5 to 10 leukocytes per high power field; 91 per cent hemoglobin, red blood cells 4,240,000; white blood cells 7,700; differential, normal; Kolmer negative; blood sugar, 87 mg.; blood urea nitrogen 12.2 mg.

In the office, methylene blue solution was injected into the normal urethra. The watery discharge through the abnormal ureteral-like opening, one inch lateral to the urinary meatus, was watched carefully for twenty minutes. Fluid continued to come through the ureteral-like orifice, crystal clear. On the other hand, bladder urine was definitely blue. This indicated that the abnormal vaginal orifice had no connection with either the urethra or bladder. The patient was then sent for cystoscopic examination to Dr. John B. Lownes, urologist at Montgomery Hospital.

Cystoscopic examination was made by the water method. Size No. 21 cystoscope passed readily. Bladder urine was perfectly clear. Ureteral orifices were normal on either side. Indigo carmine returned from each kidney in four minutes. Functions were alike and of excellent quality. Orifice, trigone and vesicle neck were normal in appearance. No dye or urine appeared from any abnormal locations.

An intravenous pyelogram was taken. Following the administration of diodrast, traces of the dye were found in both renal pelves and calyces. There were several calcified mesenteric glands lying to the left of the spine at the level of the third lumbar vertebrae. The renal shadows were partially obscured by gas in the colon.

Retrograde filling (Fig. 2) of the accessory urinary tract which emptied into the vagina, disclosed a straight tube-like structure lying medial to the right ureter and terminating in an oval pouch, corresponding to the normal renal pelvis. It was apparently a part of a supernumerary kidney.

A long paramedian incision was made 8 cm. above the umbilicus to 8 cm. below the umbilicus. The peritoneum was incised lateral to the cecum and the ascending colon, mobilizing the entire cecum and ascending colon to the medial side, thus exposing the right kidney together with the third extra kidney. The kidney was dissected free from all structures, its blood supply from the aorta and vena cava were ligated, and the ureter removed down to its entrance through Mackenrodt's ligament at the base of the uterus. Each end was ligated and severed between. At this point a small stab wound was made in the right loin and a Penrose drain inserted into the kidney area, and the peritoneum sutured back in its normal place. Sponge and pack count being correct, the parietal peritoneum was closed with chromic No. 0, muscles with chromic No. 0, fascia with cotton No. 24, subcutaneous tissue with cotton No. 40 and skin edges with cotton No. 60. Vaginal clean-up was then performed, following which the opening of the ureter which was 1 cm. lateral to the external urinary meatus was excised and the ureter followed behind the

the presence of a diffuse erythematous rash over the nose and malar eminences, a thorough investigation was performed at that hospital. The white count ranged between 10,000 and 14,000, with a normal differential. The sedimentation rate was consistently elevated. Both serology and blood cultures were normal. The urine showed no abnormalities and cultures revealed nothing abnormal. Spinal fluid revealed no abnormal contents. X-rays of the chest and gastrointestinal tract were normal. A retrograde pyelography was negative. An electrocardiogram on February 21st, was said to reveal evidence of intra-auricular conduction defect.

On admission to this hospital the patient complained of pain in the left upper quadrant, anorexia, malaise, vomiting and loss of weight. A review of his family history and his previous personal history revealed no pertinent information. On physical examination the patient was markedly emaciated, weighing ninety-eight pounds. There was an erythematous rash over the bridge of the nose and the malar eminences.

Examination of the abdomen revealed a well healed right inguinal scar. There was slight abdominal distention and an indefinite mass was felt on occasion by several investigators in the left upper quadrant. This appeared to be fixed, but could never be well defined. The mass was tender with spasm and guarding of the overlying muscles. The liver and spleen were not palpable. There was active peristalsis. The patient's finger nails and toe nails were markedly clubbed. Thorough laboratory and x-ray investigations were carried out, but other than an increased sedimentation rate and a varying leukocytosis, these were all normal or within normal limits.

On April 24, 1944, a biopsy of a cervical lymph node was performed. This was reported as revealing only hyperplasia of the lymph follicles. Because of the persistent pain in the left upper quadrant, the low grade fever, the abdominal findings and the persistent increased sedimentation rate, exploratory laporatomy was recommended. The preoperative diagnosis was a retroperitoneal lymphoma or Hodgkin's disease.

Exploration of the abdomen revealed an extensive and severe jejunitis involving 18 inches of the proximal jejunum, approximately 12 inches from the ligament of Treitz.

This portion of the jejunum was roughened and granular and had the consistency of a garden hose. In one area there was a hard
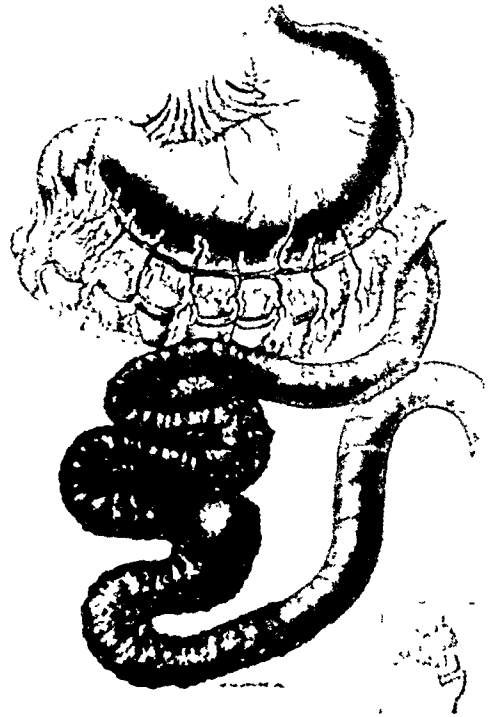
Fig. 1. A drawing of the gross pathological condition found at the first operation. There is an extensive and severe jejunitis involving the proximal jejunum. The jejunum is roughened and granular, and has the consistency of a garden hose. A hard tumor-like mass is visible. Two loops of the involved jejunum are densely adherent to each other by fistula formation. A side-to-side entero-enterostomy around the involved portion of the jejunum has been performed.

tumor-like mass which grossly gave one the impression of a malignancy. (Fig. 1.) Two loops of the involved jejunum were densely adherent to each other by a fistulous formation. There were many dense adhesions between this loop and the surrounding structures. Beyond this area the small intestine appeared normal except for the terminal ileum. This was involved for a distance of about three inches proximal to the cecum, and appeared to be in the acute phase of the disease process. Because of the patient's poor general condition, a side-to-side entero-enterostomy around the involved portion of the jejunum was performed. (Fig. 1.)

Postoperatively the patient made an uneventful convalescence until June 15, 1944, when his temperature rose, his pulse became

NON-SPECIFIC REGIONAL JEJUNITIS

MAJOR SAM GENDEL AND LIEUT. COL. MEREDITH G. BEAVER

MEDICAL CORPS, ARMY OF THE UNITED STATES

RECENTLY our attention was directed to a case of non-specific regional enteritis involving primarily the jejunum, and to a lesser extent, the ileum. It is generally accepted that these cases of chronic, non-specific ileojejunitis fall into the group of regional ileitis described by Crohn and his collaborators[3] in 1932. For it was shortly thereafter that it was recognized that the disease complex, regional ileitis, need not necessarily be confined to the ileum, but actually might involve other segments of the bowel. In 1933, Harris, Bell and Brunn[6] reported a case of non-specific ileitis in which the disease was confined solely to the jejunum. Then, in 1934, Brown, Bargen and Weber[2] observed that the colon adjacent to the involved terminal portion of the ileum could be invaded by the extension of the process to segments of the bowel distal to the ileocecal valve. The name, regional ileitis, is, therefore, perhaps an unfortunate and misleading one. To describe the possibility of involvement of any portion of the bowel by these benign granulomatous lesions, such terms as non-specific enteritis and localized chronic cicatricizing enteritis have been suggested.

While many hundreds of cases of non-specific regional enteritis have appeared in the literature, there have been but relatively few reports of involvement of the jejunum. Crohn and Yunich[4] found only seventeen cases of ileojejunitis in 200 cases of regional ileitis. In none of these was the disease confined to the jejunum alone. Johnson[5] in describing an unusual case of chronic non-specific jejunitis, also commented on the rarity of jejunal involvement. A case of regional jejunitis with many features similar to the one to be described was reported recently by Brewster[1] in a young Chinese male. This patient had involvement of the jejunum just distal to the ligament of Treitz. Under war time primitive conditions in a Methodist Mission buried away in the interior of western China near Chungking, the patient was operated upon successfully.

Although the pathology, symptomotology, roentgenologic findings and treatment of regional ileitis have been fairly well established, much less is known about these phases in the jejunal form of this disease, and certainly, more controversy exists over its management. Because of the relative rarity of regional jejunitis, and in an effort to learn more about the manifestations, course and management of this lesion, (although conclusions drawn from one case are admittedly dangerous) the following case is presented:

CASE REPORT

This twenty-two year old technician was admitted to a General Hospital from another hospital on April 1, 1944, with a diagnosis of "under observation—undiagnosed," manifested by persistent low grade fever, twenty-three pound weight loss in three months, a diffuse erythematous rash over the nose and malar eminences, increased sedimentation rate and evidence of myocardial damage by electrocardiogram.

The patient was first hospitalized in January, 1942, at another hospital, where a right inguinal herniorrhaphy was performed. His convalescence was uneventful until February 10, 1944, when he first began to vomit and complain of pain in the left upper quadrant. This pain was persistent and dull in character, superimposed by exacerbations of acute, severe, recurrent cramps. Vomiting followed the ingestion of meals, and consisted of food he had previously eaten, but never contained any blood, and was never projectile in character. It was noted at that time that he had a persistently mild elevation in temperature. Because of the vomiting, severe weight loss and

The mucosal folds become shorter and run in all directions. The wall increases in thickness up to about 1.5 cm. and the borderline between

normal appearing mucosa, except for short stretches where folds are irregular. The wall of the intestine tapers down from a thickness of

FIG. 3. A microphotograph of the involved jejunum. The changes in the mucosa are characterized by dense and diffuse infiltrations of lymphocytes, plasma cells, eosinophiles, ulcer formations and regeneration of mucosa with partial replacement of the original glands by pyloric type of glands. In places the submucosa is greatly thickened due to the presence of a gelatinous material which probably is due to stasis of lymph. There is a marked increase of fibrous connective tissue through the wall of the small intestine and extending into the mesentery. A few small abscesses are present.

the mucosa and submucosa as well as between the mesenteric fat tissue and the wall of the intestine becomes very indistinct. About 35 cm. from the proximal end the lumen of the gut narrows down to a circumference of about 1½ cm. At this point the lumen is barely passable for a medium sized probe. Beyond this obstruction there is a perforation of the wall of the gut, which communicates with the peritoneal cavity. The peritoneal opening, however, is shielded by fat pads which are glued to the peritoneal surface by fibrinous adhesions. The lumen of the intestine beyond this obstruction widens out to about 5 cm. in circumference. About 7 cm. beyond this point it narrows down again to a circumference of 2 cm. From then on until about 9 cm. proximal from the distal end, the lumen of the small intestine measures on the average 3½ cm. in circumference. The mucosal folds in this portion are small and of irregular size and run in all different directions. The last 9 cm. of the small intestine are partly lined with

about 6 mm. to about 2 mm. at the distal end. The mesentery is greatly thickened measuring up to 2½ cm. in thickness. This thickening is due to fibrous bands which partly replace the fat tissue.

Microscopic: The changes in the mucosa (Fig. 3) are characterized by dense and diffuse infiltrations of lymphocytes, plasma cells and eosinophiles, ulcer formation and regeneration of mucosa with partial replacement of the original glands by pyloric type of glands. In places the submucosa is greatly thickened due to the presence of a gelatinous material which probably is due to stasis of lymph. In addition there is marked increase of fibrous connective tissue throughout the wall of the small intestine and extending into the mesentery. This is associated with infiltrations composed of plasma cells, lymphocytes and eosinophiles. A few small abscesses are probably related to the perforation of the wall of the jejunum.

more rapid, the sedimentation rate was accelerated and a palpable, tender mass appeared in the left upper quadrant. For a

FIG. 2. Drawing of the surgically removed specimen which has been opened. The peritoneal surface of the bowel is thickened. The wall of the intestine is thicker and less flexible than normal. In a few places the wall is markedly thickened and stiff. There are areas of narrowing of the intestine, at which point there is great thickness of the wall of the gut. The mesentery of the middle portion of the loop is greatly thickened and very dense in consistency. The mucosa shows irregular folds which run in all different directions. The submucosa is greatly thickened by dense, white, fibrous tissues. At one point the gut narrows down to a circumference of about 1½ cm. At this point the lumen is barely passable for a medium size probe. Beyond this obstruction there is a perforation of the wall of the gut which communicates with the peritoneal cavity.

period of two weeks prior to this episode, he had been receiving sulfasuxidine in large doses. A clinical diagnosis of perforation of the jejunum and formation of an intraperitoneal abscess was made. Treatment was expectant until July 10th, when, because of increasing pain and tenderness in the left upper quadrant, progressive anemia, increased sedimentation rate and daily rise in temperature, it was believed that exploration was again indicated.

Consequently, on July 10, 1944, the patient was again operated upon. The involved portion of the jejunum was resected and a large intraperitoneal abscess was evacuated. The lesion showed evidence of much more extensive inflammation than was noted at the first operation. The organism isolated from the abscess was a streptococcus susceptible to penicillin. Consequently, the patient was

placed immediately on this form of therapy. He received a total of 2,750,000 units, over a period of two weeks. Improvement was gradual until August 6, 1944, when it was noted that he again began to complain of pain in the left upper quadrant, with signs and symptoms of an acute inflammatory reaction. It was thought that this probably represented an exacerbation of his intraperitoneal abscess and he was again placed on penicillin therapy, receiving 4,125,000 units, over a period of twenty-one days. The patient then went on to make a satisfactory recovery. X-rays of the terminal ileum revealed no pathology. He had gained forty-four pounds in weight when he was discharged. Postoperatively he received a total of 3,000 cc. of whole blood 3,000 cc. of plasma, 5,000 cc. of Amigen, 298 Gm. of sulfadiazine, 184 Gm. of sulfasuxidine, and 7,150,000 units of penicillin.

The pathological report was as follows:

Gross: The specimen (Fig. 2) consists of several loops of small intestine measuring approximately 75 cm. in length. The peritoneal surface of the bowel is thickened and frequently shows yellowish-white dots measuring about 1 mm. in diameter; in addition there are many remains of fibrous adhesions. In the middle portion the serosa shows extensive hemorrhages. Dense fibrous bands bind adjacent portions together thereby causing severe kinking. The wall of the intestine appears thicker than normal and is in general less flexible. In a few places the wall is markedly thickened and stiff. There is narrowing of the intestine in a few situations. In such areas there is usually great thickening of the wall of the gut. The wall of the middle portion of the small intestine is rigid and board-like. There are severe tears of the serosa and the wall of the intestine in this area. A portion of the mesentery is attached to the intestine. The mesentery of the middle portion of the loop is greatly thickened and very dense in consistency. On opening the intestine the circumference of the proximal portion measures 6 cm.; its wall measures 5 mm. in thickness. The mucosa shows rather irregular folds which run in all different directions. Occasionally folds are quite prominent and appear edematous. The submucosa is greatly thickened by dense, white fibrous tissue and there is moderate hypertrophy of the muscularis toward the middle portion of the specimen.

MULTIPLE PARATHYROID ADENOMAS*

THREE OPERATIVE EXPLORATIONS WITH REMOVAL OF TWO TUMORS

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Harper Hospital

DETROIT, MICHIGAN

MULTIPLE adenomas of the parathyroid gland are by no means uncommon. Of 160 cases of hyperparathyroidism reviewed by Castleman and Mallory,[1] ten showed involvement of two parathyroid glands. The surgeon should, therefore, at all times thoroughly explore all four poles of the thyroid as well as the substernal area. The case reported herewith emphasizes this point as well as the importance of keeping in mind the embryological origin and the anatomy of the parathyroid glands.

CASE REPORT

R. S., male, age sixty-two, was admitted to Harper Hospital, November 13, 1938, with frequency and burning on urination, attacks of postprandial nausea and vomiting, stiffness of the knees, ankles, shoulders and elbows. There was generalized muscular weakness with pain on movement of the affected joints. The urinary symptoms had been present for approximately one year. In 1917, nephrotomy was performed for the removal of three calculi from the left renal pelvis. Urinary symptoms were absent until 1937 when marked frequency developed. While there was no gross hematuria, burning or smarting, a "scraping" sensation in the urethra was noted which he thought was due to the passage of small stones. Dyspnea on slight exertion, anorexia, gaseous distention after meals, ankle edema, and a weight loss of 30 pounds developed gradually during the past two years.

There were the usual childhood diseases including typhoid fever. An injury to the left knee early in life (possibly a fracture), resulted in shortening of the left leg. Pulmonary tuberculosis in 1913 necessitated a year of sanatorium treatment with complete arrest.

Temporary "palsy" of the left arm occurred in 1917 at the time renal calculi were discovered.

The patient was of asthenic build, 70 inches tall, weighing 105 pounds, and was pale and undernourished. The eye grounds showed normal vessels with bilateral choked disc of 1.5 to 2 diopters which appeared due to a toxic condition. The perimetric fields were normal. Many teeth were missing and most of those remaining were carious. The cervical glands were enlarged. The thyroid gland was palpably enlarged. The thorax was small and thin-walled. The breath sounds were increased at both apices, but no rales were heard. The heart did not seem large to percussion; no murmurs were heard. The abdomen showed a relaxed abdominal wall; no masses were felt. The prostate was moderately enlarged, smooth and not tender. The left lower extremity was one inch shorter than the right. A few varicosities were present in both lower legs. There was a marked kyphosis involving the lower cervical and dorsal spine. On standing there was a postural deformity as a result of the kyphosis.

Cystoscopy performed by Dr. George Sewell on November 16th disclosed a mulberry stone. The bladder neck showed a median bar deformity, grade 2, and trigonitis was present. Lithopaxy was performed, the several pieces of stone removed, and the bladder washed. Analysis showed the stone to be mainly calcium carbonate. At this time the blood calcium was 15 mg. per cent, phosphorus 3.5 mg. and phosphatase 13.3 Bodansky units. The blood nitrogen was 44.4 mg. per cent. The urine showed one plus albumin with four red cells per high power field.

Roentgenograms of the skull, thorax, spine, pelvis and left thigh were reported as follows: "There is considerable demineralization of the skull with a somewhat granular appearance such as one sees in parathyroid disease. The sella turcica is normal in size and position.

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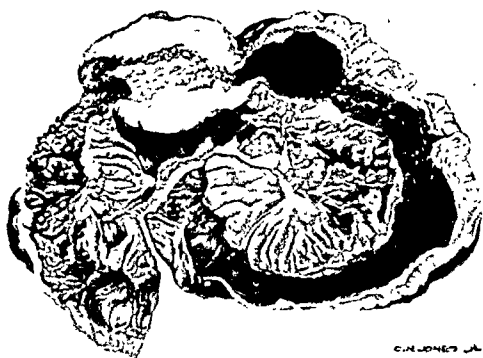

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of the lower pole of the thyroid gland was a tumor, light brown in appearance, measuring approximately 3 by 1 by 1 cm. This was dissected free by blunt dissection and removed. The right side of the thyroid-parathyroid region was not explored. The left upper pole appeared normal. The pathological report was: "markedly hyperplastic parathyroid adenoma." (Fig. 3.)

Recovery was uneventful, but pain in the elbows, back and legs persisted. The day after operation, the blood calcium was 9.3 mg.; phosphorus 2.7 mg.; phosphatase 17.9 units. Further studies were as follows:

	Cal-cium, Mg	Phos-phorus, Mg.	Phos-phatase Units
February 15th	14 0	2 4	22 2
February 21st	13 6	2 2	15 3
February 27th	14 4	2 8	24 1
March 6th	14 0	2 9	30 0
March 20th	13 2	3 0	
March 21st	12 4	2 4	
March 22nd.	12 4	2 8	
March 23rd	12 8	2 7	
The urinary calcium was:			
March 21st		1,420 cc.	0 12 Gm.
March 22nd		2,440 cc.	0 12 Gm.
March 23rd		1,575 cc.	0 11 Gm.

There was little symptomatic improvement, and in addition, he developed hoarseness due to paralysis of the left vocal cord. The patient was presented to the medical department staff conference on February 28th where the majority opinion was to the effect that since there was no response following the removal of the left-sided parathyroid adenoma, exploration of the right side should be undertaken. Subsequent observation by Dr. R. Sokolov disclosed a three-day urinary excretion of 1.26 Gm. calcium (normal about .19 Gm.).

Reoperation was performed, and careful exploration of the right side failed to disclose anything resembling a parathyroid tumor. The exploration was carried beneath the manubrium sterni and no parathyroid or any other masses could be found. After a stormy postoperative course gradual improvement and recovery occurred by March 30th, but he remained weak and still had aches and pains. The blood calcium on April 7th was 15.1 mg.;

phosphorus 2.4 mg.; and the phosphatase 34.3 units. He was discharged April 18, 1939.

However, he failed to improve despite the two operations. His weakness increased, dyspnea became more marked, and the generalized aching in the bones of his arms, legs and back increased. On May 8th the blood calcium was 14 mg. per cent; phosphorus 2.9 mg. per cent; phosphatase 19.8 units. Dr. L. Jaffe of the Out-Patient department's medical staff felt quite certain that a second tumor had been overlooked and that either further surgical search or deep x-ray therapy should be resorted to. On June 26th, the patient was readmitted to the hospital for further study. The general condition was only fair. His blood pressure was 202/110. The hemoglobin was 9.0 Gm. (65 per cent), the erythrocytes 2,500,000, leukocytes 6,200. After two weeks of treatment he showed some improvement. The hemoglobin was 10 Gm. (70 per cent) and the erythrocytes numbered 3,410,000. The urine showed one plus albumin. The blood nitrogen was 39.3 mg. per cent and the fasting sugar was 90 mg. per cent. Further blood chemistry studies were as follows:

	Blood Calcium, Mg	Phos-phorus, Mg.	Phos-phatase, Mg.
June 27th	12 8	2 7	34 0
June 30th	10 6	2 7	27 2
July 1st	14 4	2 9	31 1
July 12th	12 4	3 5	28 2
Urinary calcium—24 hour specimens.			
July 7th	1,475 cc.	.098 Gm. total specimen	
July 8th	2,425 cc.	.172 Gm. total specimen	
July 9th	2,730 cc.	.167 Gm. total specimen	

Roentgenograms of the cervical spine showed no destructive lesion, no constriction of the trachea and no evidence of thyroid shadow. The cystic areas previously reported in the ribs persisted without material change. The old tuberculous process showed no change. The heart shadow was wide, with tortuosity of the aorta. The skull plates showed no change over that previously reported nor were the changes in the lower end of the left femoral shaft altered. The conclusions of the x-ray

Many theories have been advanced regarding the direct etiology of this disease. None have been uniformly accepted. The process is apparently not tuberculous, for repeated efforts by culture, staining reactions and guinea pig inoculations have failed to demonstrate the tubercle bacillus.

As in most instances of regional enteritis, this case offered no definite information as to the underlying pathological condition. The subtending jejunal mesentery did contain many greatly enlarged lymph nodes. This has been noted in nearly all cases of non-specific regional enteritis, and has raised the possibility that the disease process might conceivably begin in the mesenteric lymph nodes or lymph channels. The observations of Reichert and Mathes[9] tend to support this theory. They were able to produce changes in the bowel wall similar to those seen in regional ileitis by injecting sclerosing agents into the lymphatics of the mesentery of the ileum in dogs. Jackson[7] has postulated that mesenteric lymphadenitis may be the causative factor. It is certainly possible, however, that the mesenteric lymphadenitis is secondary to the changes in the bowel wall, rather than their precursor. It has been siggested that ileitis may be a clinical variety of dysentery.[5] No dysentery organisms were isolated in many stool examinations in this case. It has been thought that these cases are a form of lymphogranuloma inguinale. The early involvement of the regional lymph nodes and the subsequent stage of severe cicatricial stenosis of the affected bowel have suggested this relationship. The Frei test, in this case, however, as in most cases, was negative. Although the causative agent may be a filtrable virus or the disease may be on an allergic basis, most investigators believe that the disease is bacterial in origin.

The pathological manifestations of the case were essentially those described for regional ileitis. There was an ulcerative granulomatous process, which had produced a localized mass. This granuloma, involving all walls of the intestine, had encroached upon the lumen resulting in obstructive phenomena. Moreover, an internal fistula between loops of the involved jejunum had occurred. These gross findings and the microscopic picture lend further evidence that ileojejunitis, like the more common regional ileitis, are manifestations of the same disease complex affecting different segments of the bowel. The pathological picture in this case was at variance with that described by Crohn[4] in his seventeen cases of ileojejunitis. He noted that the disease was more disseminated, that it seldom produced a mass, fistulas, or obstructive phenomena and that it was rarely amenable to surgical intervention. It has been generally considered that the extension of the disease is proximal from the terminal ileum. While this is probably true in most instances, in this particular case the extension appeared to have progressed distally. For it was noted that the earliest form of the disease was in the terminal ileum, whereas the lesions in the jejunum were in the subacute and chronic stage. The case was interpreted by the pathologist as one of regional jejunitis with the usual consequences of intestinal obstruction, tendency to fistula formation and perforation. An actual perforation into the peritoneal cavity had occurred in the central portion of the specimen, but this opening was well walled-off by fibrinous adhesions. Grossly the affected loop of the small intestine showed a marked change in character in that the circular folds were replaced by small polyp-like projections which ran in all different directions. There was a fibrous thickening of the walls of the intestine and marked involvement of the mesentery, producing a board-like induration with tremendous thickening of the mesentery of this section.

The clinical symptoms in this case are readily explained by the pathological findings. The early acute process in the terminal ileum, which later subsided, falls into the first stage of the disease, where the clinical picture is so readily confused with

acute appendicitis. The crampy abdominal pains, low grade fever, inanition and weight loss were probably due to the presence of an ulcerative enteritis with resulting loss of nourishment and fluids. Clubbing of the fingers, not infrequently found in chronic malnutrition of the intestine was another feature. These manifestations are similar to those seen in the second or ulcerative stage of terminal ileitis. The abdominal pain of a rhythmical nature and the vomiting were due to the chronic intestinal obstruction produced by encroachment upon the lumen. This stage of the disease corresponds to Crohn's[3] original description of the third or stenotic phase of regional ileitis. Later in the course of the disease the internal fistula and perforation of the lesion with resultant localized intraperitoneal abscess produced the mass, fever and abdominal tenderness and guarding characteristic of the fourth stage of the disease process.

Certainly if the diagnosis of ileojejunitis is to be made before surgery, this condition must be borne in mind. Even then, as in this case, the patient may come to surgery without a suspicion as to the exact nature of the illness. A history of recurrent pains in the left upper quadrant associated with the physical findings of anemia, a mass in the left upper quadrant, excessive peristalsis and abdominal distention, and roentgenographic evidence of dilated upper jejunal loops should suggest the possibility of regional jejunitis. This case emphasizes the point that although positive x-ray findings are not found, surgical exploration is warranted in those instances of unexplained abdominal pain, associated with a low grade inflammatory process. The disease is certainly protean in its manifestations. Clinically it must be differentiated from tuberculosis, syphilis, actinomycosis, amebic or parasitic tumors, malignancies, such as carcinoma, lymphosarcoma, Hodgkin's disease, sarcoma, nontropical sprue and deficiency states.

The early acute phase of the disease in the terminal ileum can be expected to subside spontaneously. It would appear that the present practice of non-intervention in this early stage is a wise one. If exploration is indicated, resection should not be resorted to, nor should an appendectomy be done. It is not uncommon to find that these acute cases will undergo spontaneous remissions.

However, a different problem presents itself when stenosis and obstruction have supervened. Here, surgical intervention is indicated, particularly, as in this case, when the lesion is localized to one segment of the bowel. Moreover, it would appear that whenever possible, a primary resection and anastomosis be performed. Exclusion or short circuiting operations do not necessarily arrest the disease process, and may make the second operation more difficult. In this patient, the disease process actually progressed to the point of perforation after a short circuiting operation had been performed. This rendered the resection of the diseased segment at the second operation technically more difficult and increased the hazards of the procedure. It is recognized that many of these patients are too ill, as in the case presented, to permit a resection and anastomosis in one stage, and in those instances only a short-circuiting procedure will be feasible and consistent with the survival of the patient.

While surgical intervention is the definitive treatment important consideration must be given to the pre- and postoperative nutritional problems which attend these cases. The hypoproteinemia due to the inadequate absorption of the protein components of the diet and later due to intestinal obstruction was combated by means of plasma and intravenous amino acids. The anemia was corrected by liberal use of whole blood transfusions. Vitamin supplements were administered both orally and intravenously. Infection was combated with penicillin. Sulfadiazine and sulfasuxidine appeared to have been but of little help in this respect.

SUMMARY AND CONCLUSIONS

1. An unusual and rare case of ileo-jejunitis has been presented.

2. Pathologically, this case was similar to the description of terminal ileitis, presenting a granulomatous mass involving the upper jejunum and an early lesion in the terminal ileum.

3. The symptoms and physical findings of the disease process were correlated with the various stages of the disease: (1) the acute, (2) the ulcerative, (3) the stenotic, and (4) the stage of fistula and abscess formation.

4. Surgical intervention in this form of localized jejunitis is indicated, and should consist of a one-stage resection and anamostosis whenever feasible.

5. The important considerations in the pre- and postoperative care of these patients have been outlined.

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MULTIPLE PARATHYROID ADENOMAS*

THREE OPERATIVE EXPLORATIONS WITH REMOVAL OF TWO TUMORS

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DETROIT, MICHIGAN

MULTIPLE adenomas of the parathyroid gland are by no means uncommon. Of 160 cases of hyperparathyroidism reviewed by Castleman and Mallory,[1] ten showed involvement of two parathyroid glands. The surgeon should, therefore, at all times thoroughly explore all four poles of the thyroid as well as the substernal area. The case reported herewith emphasizes this point as well as the importance of keeping in mind the embryological origin and the anatomy of the parathyroid glands.

CASE REPORT

R. S., male, age sixty-two, was admitted to Harper Hospital, November 13, 1938, with frequency and burning on urination, attacks of postprandial nausea and vomiting, stiffness of the knees, ankles, shoulders and elbows. There was generalized muscular weakness with pain on movement of the affected joints. The urinary symptoms had been present for approximately one year. In 1917, nephrotomy was performed for the removal of three calculi from the left renal pelvis. Urinary symptoms were absent until 1937 when marked frequency developed. While there was no gross hematuria, burning or smarting, a "scraping" sensation in the urethra was noted which he thought was due to the passage of small stones. Dyspnea on slight exertion, anorexia, gaseous distention after meals, ankle edema, and a weight loss of 30 pounds developed gradually during the past two years.

There were the usual childhood diseases including typhoid fever. An injury to the left knee early in life (possibly a fracture), resulted in shortening of the left leg. Pulmonary tuberculosis in 1913 necessitated a year of sanatorium treatment with complete arrest.

Temporary "palsy" of the left arm occurred in 1917 at the time renal calculi were discovered.

The patient was of asthenic build, 70 inches tall, weighing 105 pounds, and was pale and undernourished. The eye grounds showed normal vessels with bilateral choked disc of 1.5 to 2 diopters which appeared due to a toxic condition. The perimetric fields were normal. Many teeth were missing and most of those remaining were carious. The cervical glands were enlarged. The thyroid gland was palpably enlarged. The thorax was small and thin-walled. The breath sounds were increased at both apices, but no râles were heard. The heart did not seem large to percussion; no murmurs were heard. The abdomen showed a relaxed abdominal wall; no masses were felt. The prostate was moderately enlarged, smooth and not tender. The left lower extremity was one inch shorter than the right. A few varicosities were present in both lower legs. There was a marked kyphosis involving the lower cervical and dorsal spine. On standing there was a postural deformity as a result of the kyphosis.

Cystoscopy performed by Dr. George Sewell on November 16th disclosed a mulberry stone. The bladder neck showed a median bar deformity, grade 2, and trigonitis was present. Lithopaxy was performed, the several pieces of stone removed, and the bladder washed. Analysis showed the stone to be mainly calcium carbonate. At this time the blood calcium was 15 mg. per cent, phosphorus 3.5 mg. and phosphatase 13.3 Bodansky units. The blood nitrogen was 44.4 mg. per cent. The urine showed one plus albumin with four red cells per high power field.

Roentgenograms of the skull, thorax, spine, pelvis and left thigh were reported as follows: "There is considerable demineralization of the skull with a somewhat granular appearance such as one sees in parathyroid disease. The sella turcica is normal in size and position.

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"There are several shadows of calcium density in the abdomen which appear to be outside the urinary tract. There are noted

FIG. 1. Bladder calculus and cystic areas in the pelvis and left femoral neck.

numerous cystic areas in the pelvic bones and in the left femoral neck. The thoracic cage shows a number of cystic areas in the ribs and also an area of calcification within the cystic area posteriorly in the eleventh rib on the right. There is a dorsal scoliosis with its convexity toward the right and there is a marked deformity of the thoracic cage. There is a cystic enlargement in the shaft of the eighth rib on the right side in the axillary line and evidence of old fractures of the fifth rib on the right side and the seventh rib on the left side. There is considerable demineralization of the bones of the thorax and of the shoulder girdle. Marked pleural thickening is noted over both apices more marked on the right, with considerable fibrosis in both upper lobes and some calcification within this area, indicative of an old healed non-active tuberculous process." (Figs. 1 and 2.)

By Jan. 28, 1939, he developed increased pallor and dyspnea and his blood pressure was 170/95. The fasting sugar was 91 mg. per cent, non-protein nitrogen 50 mg. per cent, blood

calcium 12.6 mg. per cent, phosphorus 2.9 mg. per cent, phosphatase 25.1 units. He was placed on a fixed calcium diet of 1 Gm. of calcium

FIG. 2. Deformity of thoracic cage due to scoliosis.

daily on February 1st. The results on the twenty-four-hour urine specimens were as follows: February 2nd, 1,770 cc., total calcium .48 Gm.; February 3rd, 1,950 cc., total calcium .11 Gm.; February 5th, 2,430 cc., total calcium .67 Gm.

The phenolsulphonphthalein test showed the following: fifteen minutes, 15 per cent; thirty minutes, 10 per cent; one hour, 10 per cent; two hours, 5 per cent; a total of 40 per cent in two hours. The urine showed no Bence-Jones proteins. The electrocardiogram was reported as normal with a low RT interval of .21 seconds (normal .26 to .28). This shortened RT interval is often seen both in hyperthyroidism, whereas a prolonged RT interval is seen in hypoparathyroidism or tetany as first reported by Dr. Edward Spalding.[2]

From the symptoms and signs present, it was the opinion of both the medical and surgical consultants that a parathyroid tumor was present and surgical intervention was indicated. Accordingly, on February 8th, the patient was operated through a regular collar incision as for thyroidectomy. On the left posterior surface

of the lower pole of the thyroid gland was a tumor, light brown in appearance, measuring approximately 3 by 1 by 1 cm. This was dissected free by blunt dissection and removed. The right side of the thyroid-parathyroid region was not explored. The left upper pole appeared normal. The pathological report was: "markedly hyperplastic parathyroid adenoma." (Fig. 3.)

Recovery was uneventful, but pain in the elbows, back and legs persisted. The day after operation, the blood calcium was 9.3 mg.; phosphorus 2.7 mg.; phosphatase 17.9 units. Further studies were as follows:

	Calcium, Mg.	Phosphorus, Mg.	Phosphatase Units
February 15th	14.0	2.4	22.2
February 21st	13.6	2.2	15.3
February 27th	14.4	2.8	24.1
March 6th	14.0	2.9	30.0
March 20th	13.2	3.0	
March 21st	12.4	2.4	
March 22nd	12.4	2.8	
March 23rd	12.8	2.7	
The urinary calcium was:			
March 21st	....	1,420 cc.	0.12 Gm.
March 22nd	....	2,440 cc.	0.12 Gm.
March 23rd	....	1,575 cc.	0.11 Gm.

There was little symptomatic improvement, and in addition, he developed hoarseness due to paralysis of the left vocal cord. The patient was presented to the medical department staff conference on February 28th where the majority opinion was to the effect that since there was no response following the removal of the left-sided parathyroid adenoma, exploration of the right side should be undertaken. Subsequent observation by Dr. R. Sokolov disclosed a three-day urinary excretion of 1.26 Gm. calcium (normal about .19 Gm.).

Reoperation was performed, and careful exploration of the right side failed to disclose anything resembling a parathyroid tumor. The exploration was carried beneath the manubrium sterni and no parathyroid or any other masses could be found. After a stormy postoperative course gradual improvement and recovery occurred by March 30th, but he remained weak and still had aches and pains. The blood calcium on April 7th was 15.1 mg.;

phosphorus 2.4 mg.; and the phosphatase 34.3 units. He was discharged April 18, 1939.

However, he failed to improve despite the two operations. His weakness increased, dyspnea became more marked, and the generalized aching in the bones of his arms, legs and back increased. On May 8th the blood calcium was 14 mg. per cent; phosphorus 2.9 mg. per cent; phosphatase 19.8 units. Dr. L. Jaffe of the Out-Patient department's medical staff felt quite certain that a second tumor had been overlooked and that either further surgical search or deep x-ray therapy should be resorted to. On June 26th, the patient was readmitted to the hospital for further study. The general condition was only fair. His blood pressure was 202/110. The hemoglobin was 9.0 Gm. (65 per cent), the erythrocytes 2,500,000, leukocytes 6,200. After two weeks of treatment he showed some improvement. The hemoglobin was 10 Gm. (70 per cent) and the erythrocytes numbered 3,410,000. The urine showed one plus albumin. The blood nitrogen was 39.3 mg. per cent and the fasting sugar was 90 mg. per cent. Further blood chemistry studies were as follows:

	Blood Calcium, Mg.	Phosphorus, Mg.	Phosphatase, Mg.
June 27th	12.8	2.7	34.0
June 30th	10.6	2.7	27.2
July 1st	14.4	2.9	31.1
July 12th	12.4	3.5	28.2
Urinary calcium—24 hour specimens:			
July 7th	1,475 cc.	.098 Gm.	total specimen
July 8th	2,425 cc.	.172 Gm.	total specimen
July 9th	2,730 cc.	.167 Gm.	total specimen

Roentgenograms of the cervical spine showed no destructive lesion, no constriction of the trachea and no evidence of thyroid shadow. The cystic areas previously reported in the ribs persisted without material change. The old tuberculous process showed no change. The heart shadow was wide, with tortuosity of the aorta. The skull plates showed no change over that previously reported nor were the changes in the lower end of the left femoral shaft altered. The conclusions of the x-ray

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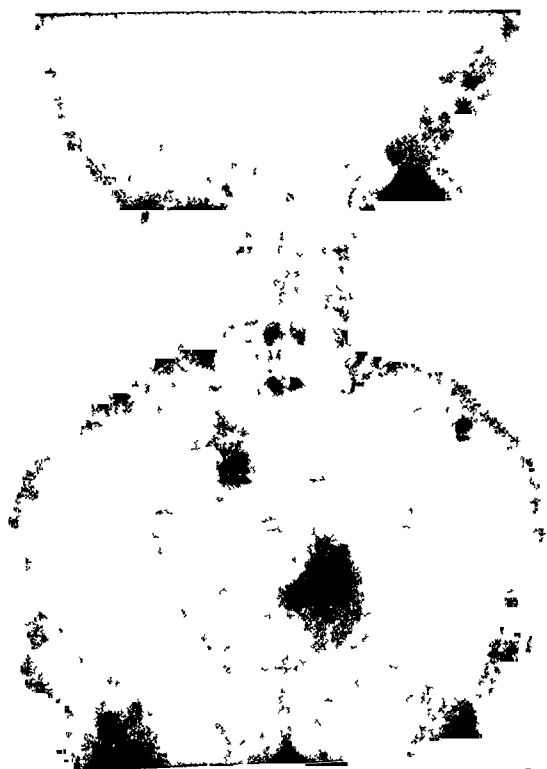FIG. 2. Deformity of thoracic cage due to scoliosis.

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	Calcium, Mg.	Phosphorus, Mg.	Phosphatase Units
February 15th	14 0	2 4	22 2
February 21st	13 6	2 2	15 3
February 27th	14 4	2 8	24 1
March 6th	14 0	2 9	30 0
March 20th	13 2	3 0	
March 21st	12 4	2 4	
March 22nd	12 4	2 8	
March 23rd	12 8	2 7	
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department were that these findings still indicated the existence of parathyroid disturbance.

On July 12th, the patient was again taken

had difficulty in swallowing, was restless, mentally confused and the pulse was feeble. The condition became worse and he expired

FIG. 3. Parathyroid adenoma, left side.
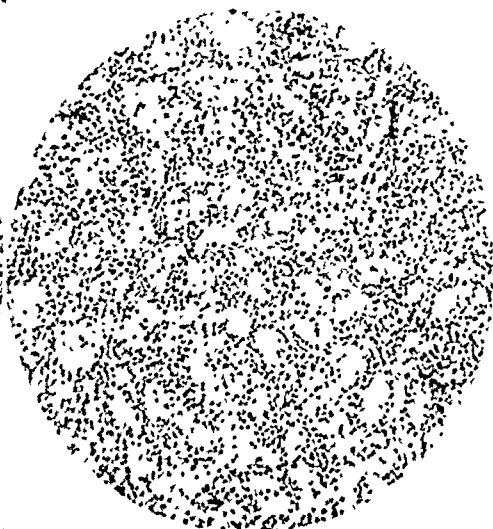
FIG. 4. Parathyroid adenoma, right side.

to the operating room. The pretracheal muscles were found quite adherent to the thyroid gland. These were dissected free and the thyroid gland brought up. The upper pole was freed and doubly clamped and ligated. The capsule of the gland was then clamped around the entire periphery and the gland removed by sharp dissection. The dissection was then carried down to the lower pole and the pole brought up by the insertion of a finger and delivered into the wound. This proved to be a yellowish-brown body measuring 1 by 0.5 by 0.5 cm. with a small dark central area, cyst-like in consistency, approximately 3 mm. in diameter. The microscopic report described the specimen as consisting of a parathyroid body intermingled with thymic remains and a portion of thyroid adenoma, with the parathyroid distinctly adenomatous. (Fig. 4.)

On the morning of July 13th, the day after operation, the patient had difficulty in breathing, was quite restless and vomited, and the pulse was of poor quality. However, he was improved later in the day. Soon the temperature rose to 101.6°F., the pulse went to 120 and the respiration to 26 per minute. On July 14th, the temperature was 97.2°F., but the pulse remained high (100 to 120). The blood calcium was 13.2 mg. and on July 15th it was 13 mg. On July 15th the pulse was around 126 and he became semiconscious and cyanotic with labored respirations. Vomiting continued. He

July 16th, three days after operation. Autopsy was not permitted.

COMMENTS

Of interest is the fact that this patient had a fibrotic type of tuberculosis in 1913 for which he had been treated for over a year. Did the usual treatment for tuberculosis twenty-five years ago in any way contribute to the development of parathyroid disturbance? Possibly the high caloric, high calcium feeding with milk that is used in tuberculosis might have placed an extra load on the parathyroids which may have become hyperplastic. That such a state may exist for a long time is claimed in the case reported by Keating and Cook[3] of hyperparathyroidism in a man of fifty-seven who had the first renal colic twenty-five years before followed by intermittent colics at irregular intervals, frequently associated with the passage of sand and gravel. Their patient did not have evidence of osteoporosis or osteitis fibrosa cystica, the only symptoms produced by the disease being related to the formation of a multitude of renal calculi over a period of many years. It is of importance that the case reported in the present paper was found to have a renal calculus twenty-one years

before the first parathyroidectomy was done. Was the hyperparathyroidism present at that time? If so, the classical symptoms were not present. Gutman lists the major symptoms in 150 cases of hyperparathyroidism as follows:

	Major Initial Symptoms, Per Cent	Major Late Symptoms, Per Cent
Skeletal		
1. Pain in the back or extremities	71	59
2. Muscle weakness	21	22
3. Pathologic fractures	27	36
4. Bone swellings	24	18
5. Gross deformities	17	35
6. Disturbance in gait	23	21
7. Bedfast	3	27
Renal		
1. Polyuria and polydipsia	9	12
2. Renal colic	9	4
Gastrointestinal		
1. Nausea, vomiting and anorexia	12	20
2. Epigastric pain	2	5
Miscellaneous		
1. Marked loss of weight	12	25

Could it be possible that the hyperparathyroidism was present in subclinical form and therefore not detected for a period of twenty-one years? What part if any could be ascribed to the pulmonary tuberculosis in the development of this condition? Unfortunately satisfactory answers to these speculations are not at present available.

What about the operative procedures? This case forcefully illustrates the importance of exhaustive exploration on both sides even when a large tumor is found on only one side. The third operation showed that the second tumor was located in its original embryological site, namely, in the region of the third and fourth pharyngeal pouches, in line with the thymus anlage. The fact that the thymic tissue was adherent to the parathyroid adenoma supports this view. It also serves to stress the admonition of Cope[5] that the problems of parathyroid surgery are not those of the regional anatomy of the neck, but are peculiar to the anatomy and physiology of the parathyroid glands. He states that special training is required and that the technical skill adequate for the successful extirpation of the thyroid gland is not sufficient for parathyroid surgery. He cites nine cases with previous unsuccessful attempts in which the patients were operated upon by thirteen surgeons all skilled in the surgery of the thyroid gland. In these cases not only were the tumors not found, but several of the surgeons intentionally removed what they considered to be normal parathyroid tissue, a procedure without justification. That a surgeon must be on his guard and explore all regions where parathyroid tissue may be found is illustrated by our case and by Snapper[6] in his medical clinics on bone diseases. He cites the first American case of hyperparathyroidism, that of Hannan, Sharr, MacClellan and Dubois in which seven operations were performed before the parathyroid tumor was found.

SUMMARY

A case is reported of a sixty-two-year-old male who had pulmonary tuberculosis twenty-five years before admission to the hospital; a left nephrotomy for the removal of multiple renal calculi twenty-one years ago; and who subsequently developed a bladder calculus with all the signs and symptoms of hyperparathyroidism. The first operation at which only the right side of the neck was explored, resulted in the removal of a parathyroid adenoma. However, the symptoms persisted as did the hypercalcemia and the elevated serum phosphatase. A second operation seven weeks later failed to reveal a second parathyroid adenoma. Further studies were continued, the patient meanwhile showing no improvement, and it was decided to reoperate a third time. A large parathyroid tumor containing remnants of thymus tissue was found on the left side. The patient died shortly afterward with evidence of cardiac failure.

The question of what influence, if any, the treatment for pulmonary tuberculosis with its high caloric diet and increased milk intake, and subsequent load on the parathyroids, is properly raised. Also the long-standing interval between the appearance of the renal calculi twenty-one years before, and the subsequent development of the typical signs and symptoms of hyperparathyroidism is discussed. Attention is called to the fact that an exhaustive exploration must be done thoroughly on both sides even though a large tumor may be readily found on one side. Cope's admonition that the problems of parathyroid surgery are not those of the regional anatomy of the neck, but are peculiar to the anatomy and physiology of the para-thyroid glands, should be emphasized. Likewise special training is required for this type of surgery.

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SARCOMA OF THE RECTUM*

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TRUE primary sarcoma of the rectum is a rare disease. Scant mention is made of it in most texts, including the encyclopedias of medicine and surgery. It is probable that in every 200 to 250 sarcomas one is of rectal origin. About one rectal malignancy in 200 is a sarcoma.

In 1927, Weeks[1] reviewed the literature and found only 100 cases of sarcoma of the rectum. He stated that if doubtful cases were excluded, only fifty would remain as true primary sarcomas of the rectum.

The literature since 1927 reveals fifty additional cases of rectal sarcoma reported as follows: Lymphosarcoma twenty-seven, spindle cell sarcoma eleven, myosarcoma eight, fibrosarcoma two, round cell sarcoma one, and one case of sarcoma of the rectum, without mention of the histological type.

Neither these cases nor those reviewed by Weeks include melanosarcoma, since pigmented tumors are not definitely thought to be of connective tissue origin. It is questionable whether pigmented tumors are primary in the rectum or secondary from skin melanomas, which have a predilection for the intestine as do melanotic sarcomas of the eye. A survey of the literature indicates that pigmented tumors occur twice as frequently as unpigmented tumors.

Other forms of sarcoma which appear primary in the rectum may be extensions from primary sarcoma of the prostate, uterus, vagina, or in the case of lymphosarcoma may be part of a generalized process in which other tissues are concurrently involved.

Many rectal sarcomas are never reported for they may be treated locally with radium, or, if pedunculated, may be removed without any histological study.

Moreover, tissues may be removed with no further diagnosis other than "neoplastic disease."

CASE REPORT

S. T., a well developed and well nourished colored male, aged sixty-four, was first seen, November 10, 1944, at Emergency Hospital, Washington, D. C., complaining of difficulty with urinary stream, having had a stricture for many years. In addition he complained of a "heavy feeling" in the rectum of two years' duration. A year prior to consultation he began having rectal pain immediately after defecation. About two months before admission he noted spotting of bright red blood in the stool. The stools were slightly smaller and narrower than normal, but were otherwise normal in color. He was not constipated and did not have diarrhea. He stated that he had been treated for "piles" elsewhere during the preceding year but had refused operation. His general health had been very good, except for the above complaints. His only operation, one for varicose veins, had been performed forty years previously.

The head, neck and chest revealed no abnormalities. The blood pressure was 120/80. The abdomen was soft with no masses or tenderness. The liver was not enlarged and the spleen was not palpable. Digital examination of the rectum was painful and revealed a smooth mass on the posterior wall, about 2½ inches long, and 2 inches wide, bulging out the posterior wall into the lumen for a distance of 2 cm. The lower border of the mass was just at the anorectal line, where there were two small scarred areas between which was a small recess simulating a healed fistulous opening. The mucous membrane over the mass was intact and smooth. The blood and urine examinations were within normal limits. X-ray of the spine, pelvis and hips showed no abnormalities.

Impressions at that time were: (1) possible neoplastic disease; (2) meningocele (?); (3)

possible old healed inflammatory lesion with fistula formation.

The patient was seen by a consultant who

mucous membrane was so friable that the probe had been admitted without resistance. An incision was made through the mass, down to
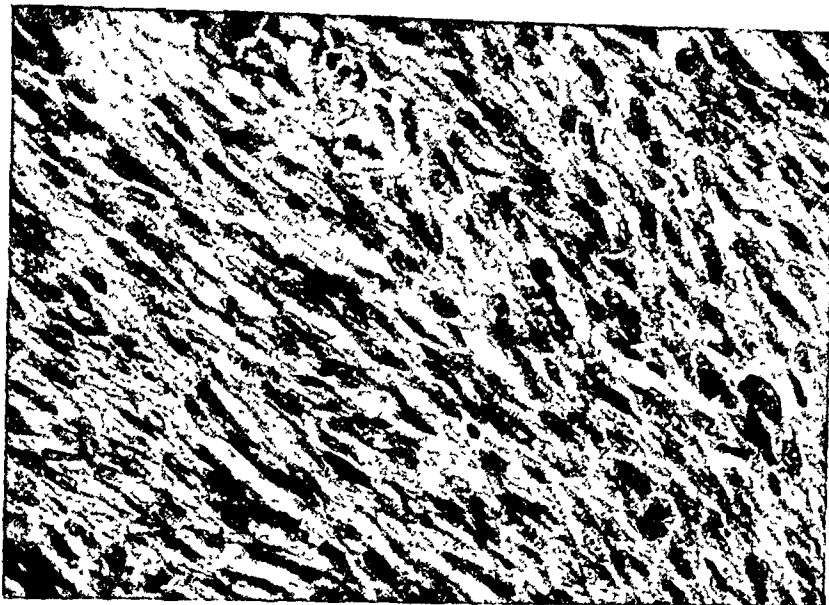
FIG. 1. The section shows a fairly large portion of intact mucosa with definitely outlined lymphoid follicles attached to the mucosa as an extremely vascular submucosa layer. Arising from the muscular coat and pushing into the submucosa is a highly cellular tumor with definite lymph spaces. The section illustrated shows cellular component of the tumor to be a large spindle cell with a large vesicular partially hyperchromatic nucleus. Some of the nuclei are pale staining. The chromatine of the nucleus is scattered in dots throughout the nuclear substance. Some of the cells are oval-shaped and elongated instead of true spindle-shaped. Mitoses are present in moderate numbers. The cytoplasm of the cells appear scanty and feeble staining. There are scattered focci of chronic inflammatory cells. In places the tumor is hemorrhagic and presents a somewhat palisaded and whorled structure. Giant cells are not present. The overall picture is that of an atypical and irregular and, due to the shape of the cell, fibroblastic sarcoma, arising from the fibrous connective tissue of the muscularis of the rectum.

was of the opinion that although the soft tumor felt like a meningocele it was probably too low down and that more likely it was an old inflammatory lesion which had subsided, and had left a cystic accumulation. Drainage and fistulectomy in one or two stages was recommended.

On November 13, 1944, under spinal anesthesia, the rectum was dilated and the mass visualized, confirming the digital finding. A needle was inserted into the cystic area, but no fluid could be aspirated. At the anorectal line a probe was passed into the recess between the two scarred areas and it passed easily up into the cystic area. It was through this point that the bleeding probably occurred. The probe came through at the upper angle of the mass, but it was doubtful whether there had been a pre-existing passage or whether the

the probe, and the area was examined digitally. The tract extended posteriorly above and behind the sphincter ani. No fluid escaped, but the area contained soft, spongy, friable granulation-like tissue which bled so freely as to require packing. The tissue appeared neoplastic and a section taken for biopsy was later reported by the pathologist as follows: "Very cellular connective tissue structure, in which the predominating cell is spindle. It is very vascular and the cells are arranged radially around some of the vessels. Mitotic figures are rare. Diagnosis: *Spindle Cell Sarcoma of the Rectal Wall, Grade II.*"

On November 29, 1944, after a preoperative regimen of sulfasuxidine, transfusions, vitamins, etc., a Lockhart-Mummary resection of the rectum with a permanent abdominal colostomy was performed under continuous

spinal anesthesia. No glands were palpable in the mesentery of the rectosigmoid and no metastases were noted in the liver. Examination of the specimen removed showed that the mass had developed completely in the rectal wall between the serosa and the mucosa. The accompanying illustration (Fig. 1) and histological report indicate that the lesion was a primary spindle cell sarcoma.

The patient had an uneventful recovery, his temperature returning to normal on the sixth postoperative day and remaining so during the rest of his hospital stay. He was discharged December 30, 1944, improved, and wearing a colostomy cup.

The patient was seen at intervals thereafter. On February 26, 1945, the posterior wound was completely healed, the colostomy was working well, and he had gained some weight, making him stouter than he wanted to be. When asked how he felt he stated: "I haven't felt better in the last twenty years." On May 18, 1945, the colostomy was still working well. There was a slight mucous discharge from the distal loop. The patient had no pain, his appetite was excellent, and he was in good spirits.

The patient was again seen on December 13, 1945, at which time he was found to be in excellent health. He was keeping his weight down to 163 pounds which he felt would increase if he took an unrestricted diet.

The colostomy was functioning well and the patient had two bowel movements per day without enemas. There was no pain in the perineal region and no evidence of recurrence. The patient's only complaint was from urinary discomfort due to the old stricture for which he was referred back to the urologist.

The patient, therefore, has gone an additional six months or a total of one year since operation with apparent complete cure.

GENERAL CONSIDERATIONS

Sarcomas are highly vascular tumors of connective tissue origin. In the rectum, they usually arise from the submucosa, but may arise from the muscularis or subserous coats. In the usual case, a rectal sarcoma starts as a small nodule, just below the mucosa. The tumor may be on either the anterior or posterior wall (the reports in the literature varying as to the most frequent site). Since the tumor is usually situated low down and just inside the sphincter area, it may be mistaken for hemorrhoids and treated as such. It may prolapse through the anus, simulating a prolapsed internal hemorrhoid, and be replaced by the patient. The growth gradually enlarges and protrudes into the rectum, giving the lumen a half-moon appearance, and it may attain a size larger than one's fist. Other types are pedunculated and may have a stalk or a sessile base. The mucosa is usually intact and moves over the tumor. In this stage it should be readily distinguished from carcinoma, in which the mucosa is usually ulcerated, fixed or heavily scarred, as is characteristic of a tumor of the mucous membrane. The sarcoma gradually outgrows its blood supply, and by pressure the mucosa over it may ulcerate. At this stage it may readily simulate carcinoma. The usual soft spongy tumor bleeds easily and although this is a late symptom it is the one that most commonly brings the patient to the doctor. By contrast some lesions may be rather solid and produce symptoms of weight, fullness and a sense of incomplete bowel movement.

Pain is an infrequent symptom and occurs late, usually when the tumor ulcerates or becomes large enough to cause pressure symptoms. More often the patient has constipation and a sense of fullness in the rectum, often feeling that he has not completely emptied the rectum after defecation. The act of defecation may be very painful.

Since sarcomas usually metastasize by the blood stream, the liver is involved early and the inguinal lymph glands are not involved. Carcinoma on the other hand metastasizes via the lymphatics to the glands of the rectosigmoid mesentery and then to the preaortic glands and later to the liver. Occasionally, the inguinal glands may be palpable in squamous carcinoma of the anorectal region.

Sarcomas are more frequent in the male than in the female, with a ratio of 5 to 1. The average age is about forty-five years,

but cases are recorded between the ages of thirty-five to eighty-one. Johennessen[27] reports a case of sarcoma of the rectum in a child one year of age, in which the tumor filled the rectum. The tumor grew rapidly and palpable metastases were present in the abdomen. Three months after admission to the hospital, the child died from hemorrhage of an ulcerated vessel of the tumor. It is interesting to note that examination of the mother revealed a breast cancer with axillary metastases.

DIFFERENTIAL DIAGNOSIS

The infiltrating forms of rectal sarcoma may be confused with syphilitic stricture, but syphilitic lesions are slower growing, subside under anti-luetic treatment, have positive serology, and do not metastasize.

A polypoid sarcoma may simulate an adenoma and gross differential diagnoses may be most difficult. Adenomas move freely with the mucosa, while in pedunculated sarcoma, the base is thick and may be hard and attached to the underlying tissue. In adenoma the mucosa often is soft and prolapses with the tumor.

A granulomatous type of tuberculous lesion may be confused with sarcoma, but these too are slower growing and usually there is evidence of tuberculosis elsewhere in the body.

While the differentiation between sarcoma and carcinoma is confusing, the matter is academic, since the treatment is essentially the same for both. The most confusing differential diagnoses are encountered in distinguishing between a non-ulcerating carcinoma and a sarcoma, and an ulcerating sarcoma and a carcinoma. Carcinoma produces annular constriction; the mucosa is part of the tumor; it often ulcerates early; it may be less voluminous; cachexia appears sooner; it produces palpable lymph nodes; it is almost never pigmented and it causes pain early. Sarcoma on the other hand may not involve the inguinal glands, but invades the liver or lungs early and produces an early voluminous rectal tumor, with usually an

intact mucosal covering that moves freely over the tumor. Sometimes the mass or swelling has a soft or cystic feel, as was true in the reported case. Definite diagnosis is made by biopsy.

Biopsy is thought by some to be a bad procedure in the spread of neoplasms. It should be done, but done carefully and without too much trauma. Smith[6] properly states "that biopsy correctly done seems less likely to aggravate metastases, than digital examination, too crudely performed."

TREATMENT

Conservative measures of treatment are rarely indicated. Local excision alone, with or without radium or x-ray therapy is followed by a high percentage of recurrences. Therefore, early radical excision is the procedure of choice and the one that gives the patient the best possible chance of cure and comfort, be it a few months or several years. The average postoperative survival time is about eleven and one-half months. However, cases are reported in which the patient lived four to five years after surgery.

CONCLUSIONS

1. True primary sarcoma of the rectum is a rare disease. One in every 200 to 250 sarcomas are rectal. One rectal malignancy in 200 is sarcoma.

2. In 1927, Weeks' review of the literature revealed 100 cases of rectal sarcoma, one-half of which are of doubtful origin. Since that time a review of the literature reveals fifty additional cases. Pigmented tumors are not included.

3. A case of spindle cell sarcoma of the rectum is reported in a man sixty-four years of age, who was still living and asymptomatic seven months after operation.

4. The points of diagnosis and differentiation are discussed, especially in relation to carcinoma.

5. The treatment of choice is early radical excision, since radium, x-ray and

local excision are followed by a high percentage of recurrence and give uniformly bad results.

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THE USE OF A GUIDE SUTURE IN STRANGULATED HERNIA

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THE mortality, after simple repair of strangulated hernia, is rather high and increases enormously if the repair calls for additional bowel surgery. Frankau's statistics illustrate this statement clearly. His study, initiated by the Association of Surgeons of Great Britain and Ireland, is based on the case records of 1,487 strangulated hernias of different types from a large number of different surgical centers. Of the 1,487 strangulated inguinal, femoral and umbilical hernias there was a mortality of 15.7 per cent following simple herniorrhaphy. In 105 cases, or 7 per cent of all the cases, resection was done followed by a mortality rate of 42.8 per cent. These figures show clearly that the decrease in the incidence of resection will lessen markedly the mortality rate following surgical intervention for the relief of strangulated hernias.

The difficulty is to eliminate the necessity of resection in these borderline cases, in which even the best trained and most experienced surgeon is faced with a serious problem.

The management of strangulated hernias as usually advocated is about as follows: Soon after the cause of strangulation is removed or the constriction band divided, the hernial sac is opened and its content inspected. The strangulated herniated bowel is covered with warm moist lap packs or towels, and oxygen is given to the patient. The color of the damaged bowel should improve considerably within ten to twenty minutes; and if the viability seems to be assured, the bowel is replaced into the abdominal cavity. The repair of the hernia is then carried out.

However, in certain borderline cases the damaged bowel, treated in accordance with the routine described, may not respond in an entirely convincing manner so that the thought of possible resection may seem to be indicated. However, the damaged bowel might respond more favorably under more physiological conditions. The ideal environment for the bowel naturally is the abdominal cavity itself with its moisture and warmth. Replacing the damaged bowel into the abdominal cavity should provide the most favorable possible condition for the recovery of the damaged bowel.

One of the principal objections to this type of handling is the technical difficulty of being able to recover and recognize the damaged bowel after its replacement in the abdominal cavity. The internal ring is usually too small for very successful manipulation; also, additional damage to the bowel may result from excessive handling.

By the use of a guide, or identifying suture, we believe we have found a partial solution to this problem. A fine black cotton thread suture, No. 70, No. 80 or No. 100 size, threaded on a fine baby Ferguson needle is carried through the seromuscular layer of the healthy part of the bowel about ½ to 1 inch from the demarcation line. (Figs. 1 and 2.) The needle is removed and both ends of the suture, without being tied, are held together by a mosquito hemostat without exerting tension on the bowel. The strangulated bowel is then replaced into the abdominal cavity and oxygen inhalation is given to the patient. We consider ten to fifteen minutes as sufficient time to establish the viability of the damaged bowel. This waiting time is utilized for the dissection of the anatomical structures

in preparation for herniorrhaphy. A slight pull on the guide suture will immediately identify the particular loop in question which now can be easily withdrawn from the abdominal cavity. If inspection of the bowel should not indicate its viability, additional bowel surgery may then be unavoidable.

The following cases reported are of the borderline type. Without having used the guide suture some of these cases may have been subjected to unnecessary additional surgery with all its risks and dangers.

CASE REPORTS

CASE I. B. W., a sixty-two year old white male, was admitted to the Charleston General Hospital on October 2, 1944, with the complaint of painful swelling in the right inguinal and scrotal region of about two days' duration. The patient had known for the past six months that he had a right inguinal hernia. For the last week this hernia had descended at times but was always reducible. The day before admission the hernia again descended but could be reduced neither by himself nor his family physician. Pain was experienced at the site of the hernia and umbilical region, increasing gradually in intensity. There had been no bowel movements since incarceration of the hernia. The patient attempted to take magnesium sulfate but vomited it immediately.

Examination revealed marked tenderness and rebound tenderness over the right inguinal region with slight swelling. Chronic eczema involved the right lower quadrant and right inguinal region. There was rebound tenderness in the right lower quadrant and in the region of the umbilicus with moderate abdominal rigidity. An irreducible tender mass could be felt in the right scrotum. The entire scrotum and penis were swollen. A complete blood count revealed 91 per cent hemoglobin, 5,100,000 erythrocytes, 7,300 leucocytes, 90 per cent lymphocytes and 81 per cent neutrophil segment. A diagnosis of strangulated right indirect inguinal hernia was made.

After preparing the patient with glucose and plasma he was taken to the operating room where, under spinal anesthesia, exploration of the strangulated hernia was performed. The hernial sac contained only small bowel. A loop four or five inches long showed signs of begin-

ning gangrene. The color of the affected loop was almost mahogany. The bowel was replaced into the abdominal cavity, using the previously described guide suture technic. After a lapse of fifteen minutes, the affected bowel in question was again inspected. The color was found to be greatly improved and strong peristaltic waves were observed. Repair of the hernia, following a modified Halsted technic, was carried out. The patient's postoperative course was rather uneventful except for a low grade postoperative infection which may have been caused by the chronic eczema previously described. He was discharged on November 9, 1944, in apparent good condition.

CASE II. A. H., a sixteen year old white boy, was admitted to the Surgical Department of the Charleston General Hospital on December 3, 1944. At 4:30 P.M. on the day prior to admission the patient felt a sudden sharp pain in the right lower quadrant. Associated with this pain he noticed a small tender mass appearing in the right inguinal region. He had not noticed either mass or hernia previously. The pain was intermittent and of a colicky nature but was not associated with vomiting or nausea. In spite of the bowel movement he had there was no relief from this severe pain.

Examination revealed an irreducible tender mass about 2 cm. in diameter in the right inguinal region. There was tenderness and rebound tenderness in the entire right lower quadrant. Muscle guarding was present. Diagnosis of strangulated right inguinal hernia was made.

Under spinal anesthesia, the right inguinal region was explored and an indirect hernia was found. The sac, which had a very narrow neck, contained small bowel of which one loop about 2½ inches long was apparently severely damaged. No peristaltic waves could be observed. However, the mesenteric vessels did not show evidence of thrombosis. Using the guide suture technic the bowel was replaced into the abdominal cavity. Inspection of the damaged bowel, after about fifteen minutes, revealed that the color had markedly improved and that definite peristaltic waves had been re-established. The hernia was repaired, using a modified Halsted technic. The patient made an uneventful recovery and was discharged on December 9, 1944, in apparent good condition.

CASE III. K. P., a sixty year old white male, was admitted to the Surgical Department of the

Charleston General Hospital on November 16, 1944, with the complaint of irreducible left inguinal hernia. About seven hours prior to

exertion, etc.). A large irreducible tender mass about 4 inches in diameter was found in the left scrotum. Tenderness and rebound tender-

FIG. 1.
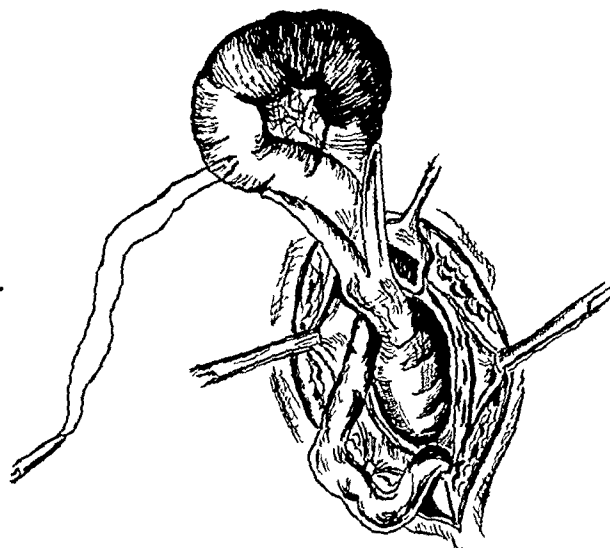
FIG. 2.
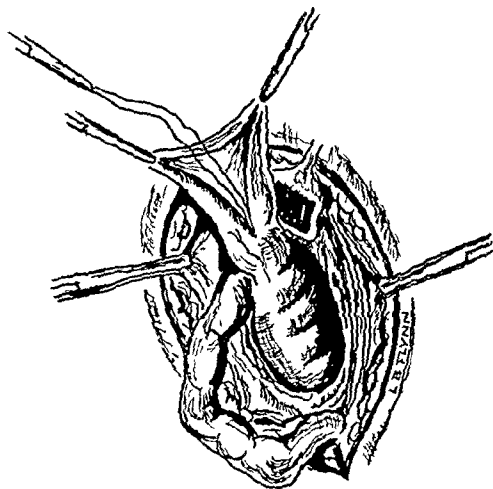
FIG. 1. Guide suture through the seromuscular layer about ½ inch from the demarcation line of the damaged part of the bowel.
FIG. 2. The bowel replaced in the abdominal cavity.

admission the patient noticed that his hernia, which he had had for many years, had descended and could not be reduced. Associated with this he noticed rather marked pain in the lower abdomen which gradually became general in character. The patient had had this hernia since he was twelve years of age and had been wearing a truss, from time to time, since the age of twenty.

Examination revealed the patient to be in rather poor general condition. His blood pressure was 200 systolic and 108 diastolic. There was a marked dorsal kyphosis, beginning heart decompensation (ankle edema, dyspnea on

ness were noted in the left lower quadrant, mainly over the left inguinal region.

A complete blood count revealed 91 per cent hemoglobin, 4,700,000 erythrocytes, 16,200 leucocytes, 87 per cent neutrophils and 13 per cent lymphocytes. Urinalysis was essentially negative except for 3 plus sugar. A diagnosis of strangulated left inguinal hernia was made.

The patient was taken immediately to the operating room where, considering his poor general condition, operation was performed under local anesthesia, a 1 per cent novocaine solution being used. A large sac was found containing a loop of small bowel about 5 inches

long. This loop was twisted and dark brownish red in color. The mesentery showed some discoloration and beginning thrombosis of the mesenteric veins. Apparently no peristaltic waves were passing through this loop. Using the guide suture technic the bowel was replaced into the abdominal cavity. Oxygen was given. After reinspection of the damaged loop marked color improvement could be noticed. The color of the mesentery was better but some of the smaller veins were thrombosed. Definite peristaltic waves could be observed. Considering this marked improvement and the patient's poor general condition it was deemed advisable not to undertake a resection. Repair, following a modified Halsted technic, was carried out. The patient's postoperative course was uneventful and he was discharged on November 22, 1944.

CASE IV. J. S., a forty-eight year old white male, was admitted to the Charleston General Hospital on February 8, 1945, complaining of pain in the region of the stomach, associated with cramping in the lower abdomen. He stated that he had noticed a rather small painless swelling in the right inguinal region for nearly three years. About one week prior to admission he had indigestion and heart burn, also some tenderness of the region of the swelling. The patient was aware that he had hypertension.

Examination revealed a forty-eight year old white male in acute abdominal distress. Temperature 99.6°F., pulse 80, respirations 20 and blood pressure 190/106. An irreducible markedly tender mass about 1 inch in diameter could be felt in the right inguinal region. There was tenderness and rebound tenderness in the entire lower abdomen, more explicit on the right. A diagnosis of right femoral hernia was made, with partial small bowel obstruction, as confirmed by a scout plate of the abdomen.

The patient was taken to the operating room and, under general anesthesia, the right femoral region was explored. A hernia was found; the sac contained a strangulated loop of small bowel about two inches long. The color of the loop was almost mahogany. A rather large amount of serous fluid escaped from the hernial sac. The guide suture technic was used and, after reinspection of the damaged bowel, marked color improvement could be noticed, likewise the peristaltic waves were reestablished. Routine repair of the femoral hernia was carried out. The patient made an uneventful recovery except during the first postoperative day, at which time generalized oozing from the incision was observed. This may have been partly due to heparinization. Heparin was discontinued. Vitamin K and coagamine were given, also a blood transfusion, after which the oozing gradually subsided. He was discharged on February 21, 1945, apparently well.

SUMMARY

1. There is statistical proof that the mortality rate after repair of strangulated hernias is high and that it is markedly increased by bowel surgery.

2. Borderline cases incidental to strangulated hernias are described, in which the damaged part of the bowel has not responded to routine management. At times it is rather difficult to evaluate the viability of such bowel.

3. The advantages of the guide suture, in this type of case, are discussed.

4. Four case reports are given.

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DIAGNOSIS OF LACERATED SPLEEN*

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TRAUMATIC lacerations of the spleen resulting from the application of blunt force to the left upper quadrant are not uncommon and constitute a serious intra-abdominal injury. During a snow storm in Philadelphia, four cases of ruptured spleen were admitted to the Jewish Hospital within a period of ten days. The patients were young boys ranging from nine to sixteen years and sustained their injury in sledding down hill at a high rate of speed.

Three types of bleeding may occur: (1) Extensive rupture of the spleen with immediate massive hemorrhage; (2) slow oozing from small splenic lacerations, and (3) delayed hemorrhage from intracapsular injury of the spleen. The latter may result in sudden and dramatic death after the patient is allowed out of bed or discharged from the hospital.

In types two and three, physical signs may be equivocal and may baffle both physician and surgeon as to the advisability of laparotomy. The most advantageous time for exploration is during the latent period before secondary hemorrhage sets in. Clinically, a very significant symptom is pain in the left shoulder aggravated by deep inspiration present in all four cases. (Two were on the service of Dr. Frank B. Block.) In one of our cases, it was the only sign present, there being no appreciable tenderness or rigidity in the abdomen during a period of three hours' observation following the injury. A cutting, stinging pain in the left shoulder was strikingly demonstrated in a twelve-year old boy every time he took a deep breath. The left shoulder pain is due to phrenic nerve irrita-tion, produced by the accumulation of blood and blood clot in the left subdiaphragmatic space. A blood count is of no special help since it may be normal in spite of a brisk splenic hemorrhage.

Roentgenographic examination of the abdomen by means of a survey film taken in the recumbent supine position yields valuable information in the early diagnois of ruptured spleen and may tip the scales of judgment in the right direction, especially when clinical symptoms are questionable or not quite clear cut. This enables us to explore the patient before massive hemorrhage manifests itself. In 1942,[1] we described a roentgenologic triad present in lacerated spleens: (1) Markedly distend stomach; (2) jagged serrated greater curvature of the stomach at the cardiac end and pars media, and (3) obliteration of the splenic shadow merging with the perisplenic hematoma.[2] When the hemorrhage is massive, there is also a depression of the transverse colon separating it considerably from the greater curvature of the stomach. The first three signs were present in all patients examined. In one of the above mentioned cases, the x-ray findings were the only convincing proof of a ruptured spleen; it unquestionably saved the patient's life by early an exploratory operation. (Fig. 1.)

The spleen is entirely covered with peritoneum and is moored by two peritoneal folds: the gastrosplenic and the lienorenal ligaments. Inferiorally it is supported by the peritoneal phrenic colic ligaments. It is our belief that the changes in the greater curvature of the stomach are due to infiltration of blood along the gastrosplenic

ligaments. It is of interest to note that the jagged serrations along the greater curvature of the stomach were still visualized

Technically, three points may be stressed: (1) On opening the peritoneal cavity and finding intra-abdominal hemorrhage, one

FIG. 1.   FIG. 2.

FIG. 1. S. G., lacerated spleen. Note gastrectasis associated with jagged serrated greater gastric curvature; normal contour of spleen distorted by perisplenic hematoma.

FIG. 2. S. G. Case II. Postoperative film following splenectomy; no gastrectasis; no evidence of splenic shadow; greater curvature still serrated due to operative manipulation of gastrolineal ligament.

FIG. 3.   FIG. 4.

FIG. 3. R. K., lacerated spleen. Note marked gastrectasis; jagged serrated cardiac portion of greater gastric curvature; obliterated splenic shadow.

FIG. 4. R. K. Case I. Postoperative film following splenectomy; no gastrectasis; no evidence of splenic shadow; greater curvature still serrated due to operative manipulation of gastrolineal ligament.

on the films taken twenty-four hours postoperatively. We ascribe this to ligatures placed on the gastrosplenic ligament in the course of the splenectomy. The stomach, however, contained much less gas than preoperatively. (Fig. 2.)

may utilize to advantage an auto-transfusion set so that is may be promptly transfused into the patient. Since the peritoneal blood is defibrinated, it need not be citrated, for it will remain liquid for at least thirty to sixty minutes allowing

one ample time to reinject it into the patient's vein. Retrieving the intraperito-neal blood is facilitated by making initially

FIG. 5. B. R., lacerated liver. Markedly enlarged liver with considerable depression of hepatic flexure of colon; no previous history of hepatomegaly.

a small peritoneal incision and suctioning the bulk of the free blood prior to enlarging the incision for operation. (2) Delivery of the spleen is greatly aided by severing the phrenicocolic ligament. This enables one to ligate the splenic artery and vein in the splenorenal ligament under direct vision. (3) In ligating the gastrosplenic ligament, one should be extremely careful not to ligate the greater curvature of the stomach which is in juxtaposition to the splenic hilum. One should carefully inspect the splenic bed for small remnants of splenic tissue; these must be removed to obviate the possibility of multiple splenic implants in future life.

It is well known that following splenectomy for familial hemolytic jaundice, there is marked postoperative rise in platelets. Removal of a physiologically normal spleen following trauma is also followed by an increased platelet count, though there is an individual variation in

the degree of platelet reaction. The following are the daily postoperative platelet counts in the two cases:

SG, Operation

1/21/45	Day of operation	
1/22/45 A.M.		133,400
1/23/45 P.M.		179,550
1/23/45 A.M.		194,040
1/24/45 A.M.		468,280
1/24/45 P.M.		505,040
1/25/45		500,990
1/26/45		482,510
1/29/45		301,920
1/30/45		244,020
1/31/45		616,000

RK, Operation

1/21/45	Day of operation	
1/22/45		659,330
1/23/45		237,120
1/27/45		343,650
2/24/45		213,120

CASE REPORTS

CASE 1. R. E. K. The patient, a sixteen-year old male, gave a history of sledding down a hill, "belly-flopping" and bumping into a tree. He struck the left side and immediately complained of difficulty in respiration. The accident occurred at 2:50 P.M. On admission to the hospital on the service of Dr. Ralph Goldsmith, the patient complained of severe left shoulder pain. Physical examination revealed some rigidity and tenderness in the left upper quadrant.

Clinical diagnosis: Probably traumatic injury to the spleen with minimal bleeding.

His pulse was 80 on admission; temperature, normal; blood pressure, 108/80; white blood count: 5,000; 73 polymorphonuclears, 26 lymphocytes, 1 monocyte.

A survey film of the abdomen revealed a markedly dilated stomach, serrations along the greater curvature of the stomach and a distinct obliteration of the splenic shadow which became continuous with the perisplenic hematoma and impinged against the greater curvature of the stomach. (Fig. 3.)

Operation (by Dr. Samuel Levine) revealed a badly lacerated spleen with about 700 cc. of blood. Some of the peritoneal blood was reinjected into the patient by means of the auto-transfusion technic.

The patient made an uneventful recovery and was discharged on the fourteenth postoperative day.

a lacerated spleen with about 750 cc. of blood within the peritoneal cavity; 400 cc. of the blood were reinjected into the patient through

FIG. 6. L. W., contusion of right kidney with massive hematuria; no evidence of gastrectasis; gas largely in the colonic tract.
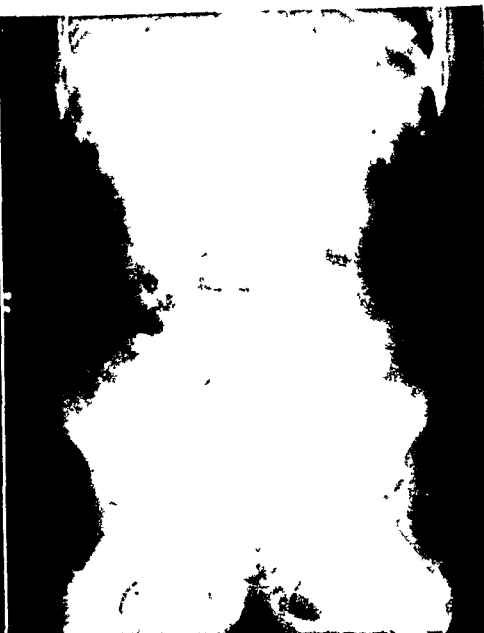
FIG. 7. H. W., lacerated liver. Increased hepatic shadow, depressing the hepatic flexure; small magenblase; absent gastrectasis.

CASE II. S. G. The patient was admitted to the hospital on the service of Dr. Ralph Goldsmith, one-half hour after a sledding injury in which he struck a tree. On arrival in the Accident Ward the patient had excruciating pain in the left shoulder.

The physical examination revealed no rigidity of the abdomen. There was slight tenderness in the left upper quadrant. The temperature was normal; pulse 85; respiration 20.

The patient had no symptoms beyond the left shoulder joint pain. A diagnosis of splenic rupture or any intraperitoneal injury could not be definitely made on physical examination.

Blood count on admission was 4.6 red blood cells; 9,000 white blood cells, 90 per cent polymorphonuclears 6 per cent lymphocytes, 4 per cent monocytes.

A survey film of the abdomen showed marked gastrectasis and serration of the greater curvature. There was obliteration of the splenic shadow depressing the splenic flexure. There was no evidence of fracture of any of the lower seven ribs on the left side. The left diaphragm was not elevated.

Operation (by Dr. Samuel Levine) revealed

an auto-transfusion set. A splenectomy was done and the abdomen closed in layers. The patient made an uneventful recovery and was discharged on the seventeenth postoperative day. (Fig. 5.)

Various roentgenographic aids have been described in the diagnosis of splenic injury. Among these may be mentioned: (1) tenting of the left diaphragm (J. M. Deaver),[3] (2) displacement of the splenic flexure (Zabinski and Harkins)[4] and (3) administration of barium in Trendelenburg position to note gastric displacement (Bancroft). Some of the above procedures are undesirable because they entail manipulation of rather sick patients and may aggravate intra-abdominal hemorrhage. (Fig. 6.)

O'Neil and Rousseau[5] confirm the constancy and reliability of the signs mentioned above in the diagnosis of splenic laceration as well as the absence of the triad in renal and hepatic lacerations.

CONCLUSION

1. A roentgenographic method is offered as an aid in the early diagnosis of splenic lacerations.

2. The desirability of an auto-transfusion set is stressed as a means of combatting blood loss in intraperitoneal hemorrhage.

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Acute pancreatic hemorrhage or pancreatic apoplexy is often fatal in from a few hours to seven days. When there is less destructive hemorrhage or necrosis the patient may live days or weeks without operation and recovery may result.

From "Principles and Practice of Surgery" by W. Wayne Babcock (Lea & Febiger).

CONSERVATIVE TREATMENT OF A CHRONIC AMEBIC LIVER ABSCESS COMPLICATED BY RUPTURE AND AN INTRAPERITONEAL ABSCESS

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IT has been clearly demonstrated that most large solitary uncomplicated amebic liver abscesses can be cured by the use of emetine hydrochloride combined with aspiration of the abscess with a very low mortality rate. When the abscess is complicated by rupture and a localized abscess forms, open surgical drainage through an extraserous approach has been the procedure of choice with its attendant higher mortality rate. The case reported here is of interest in that it was complicated by rupture with the formation of an intraperitoneal abscess and was treated successfully by the use of emetine hydrochloride and multiple aspirations.

CASE REPORT

A sergeant, who is now thirty-eight years old, arrived in India in May, 1942. He was hospitalized for three periods of about one month each beginning in September, 1942, because of malaise, fever, weakness, and a watery diarrhea characterized by fifteen to twenty stools a day, many of which contained blood. On these occasions the diagnosis of bacillary dysentery was made and the diarrhea cleared up after sulfaguanidine therapy but recurred each time within a week or two after he returned to duty. His weight decreased from 165 to 125 pounds. He entered a hospital for the fourth time in February 1943 and for the first time Entameba histolytica were found in his stools. No enlargement of the liver was noted at this time and sigmoidoscopic examination failed to show any ulceration in the lower sigmoid colon and rectum. Although he received 300 gr. (18 Gm.) of carbarsone over a period of two months, he failed to make any substantial improvement and was accordingly evacuated to the United States in May, 1943. While on board ship he again developed a diarrhea and was given a total of 5 gr. (0.30 Gm.) of

emetine hydrochloride in daily 1 gr. (0.06 Gm.) injections with marked improvement in his symptoms. Shortly after his arrival at a General Hospital in this country in June, 1943, his diarrhea had subsided, his weight had returned to 150 pounds, and the patient felt better than he had since his illness began. Abdominal examination was again essentially negative but the sigmoidoscopic examination on July 4, 1943, revealed numerous shallow ulcers in the rectum. No ameba were found in the stools and serum agglutination tests for the Shiga dysentery-paradysentery group were negative. The sedimentation rate was normal. He was given a ten-day course of emetine by injection, 1 gr (0.06 Gm.) a day and a ten-day course of carbarsone, 3.75 gr. (0.225 Gm.) twice a day. The ulceration had completely disappeared by August 2, 1943, and the patient was returned to general military duty as cured on August 5, 1943.

He continued to perform full duty until January 10, 1944, at which time he was admitted to a Station Hospital because of a nonradiating pain in the upper right quadrant of his abdomen of twenty-four hours' duration. He stated that he had been quite weak for some time and that for the month preceding the admission there had been a fullness in the right upper quadrant of the abdomen accompanied by dyspepsia occurring most frequently after eating. He had been having one soft bowel movement a day and recently had noted that the stools were a little lighter in color than they had been previously. His weight had dropped from 150 to 135 pounds in the month preceding his admission to the hospital. The patient attributed this to lack of appetite. On inspection of the abdomen at the Station Hospital a slight rounded prominence was noted in the right upper quadrant with a sensation of deep fluctuation on palpation, although this was difficult to determine due to the tenderness and localized rigidity in this area. The liver edge of the right lobe was palpated about 6 cm. below

the right costal margin and was extremely tender. The temperature on admission was 98.8°F. and ranged to 100°F. The leukocyte with a differential of neutrophils 92 per cent, lymphocytes 6 per cent, eosinophils 1 per cent, and monocytes 1 per cent. With these increas-
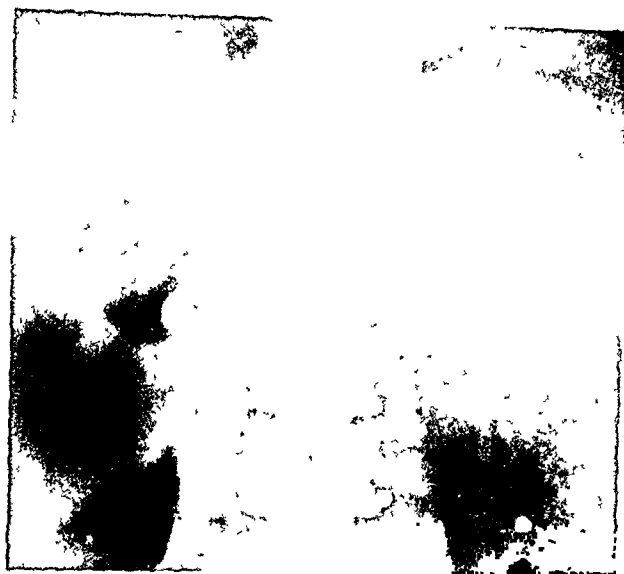
FIG. 1. Anteroposterior roentgenogram showing amebic abscess in right lobe of the liver visualized by air after fourth aspiration. Note that there is no abnormal elevation of the diaphragm.

count was 16,350 with a differential of neutrophils 88 per cent, lymphocytes 9 per cent, eosinophils 2 per cent, and basophils 1 per cent. The urinalysis was essentially normal and in one stool examination no Entameba histolytica were found. Sigmoidoscopic examination was negative. He was given an intramuscular injection of ½ gr. (0.03 Gm.) and 1 gr. (0.06 Gm.) of emetine hydrochloride, respectively, on two successive days and transferred to a General Hospital on January 12, 1944, with a diagnosis of amebic liver abscess.

On admission the patient was still complaining of severe pain in the right upper abdominal quadrant and the physical findings were essentially as described in the Station Hospital record. The temperature was 98.8°F., the pulse was regular and 80 beats to the minute, and the respiration was 22 per minute. The leukocyte count was 16,900 with a differential of neutrophils 85 per cent, lymphocytes 7 per cent, eosinophils 3 per cent, and monocytes 5 per cent. The sedimentation rate was 118 mm. per hour. Within forty-eight hours after admission the pain became diffuse over the entire abdomen, some vomiting had occurred, and generalized tenderness and rigidity of the abdomen had developed. No peristalsis could be heard. The leukocyte count rose to 17,500

ing symptoms the patient showed an increase in temperature to 100°F. on one occasion but at no time during his subsequent course did he again develop a fever. X-ray studies of the abdomen at this time showed that there was no elevation of the diaphragm. The liver shadow was enlarged, the inferior border overshadowing the right kidney, and there was x-ray evidence of free fluid in the peritoneal cavity. Clinically it was believed that this patient had a chronic amebic liver abscess which on January 9, 1944, had ruptured and formed a localized intraperitoneal abscess, and that in the past forty-eight hours there probably had been a slight leakage into the general peritoneal cavity.

Immediate treatment consisted in continuing the daily intramuscular injections of 1 gr. (0.06 Gm.) of emetine hydrochloride for eight days, parenteral fluids as needed, and on January 14, 1944, about 150 cc. of thick, chocolate colored pus were aspirated with a large bore needle from the right hypochondrium. The needle was inserted just below the right costal margin in the midclavicular line to a depth of about 4 cm. The impression was that the point of the needle was just through the peritoneum. The aspirated pus was negative for organisms and ameba on smear and culture.

Following this first aspiration the diffuse abdominal pain and rigidity receded, and the extremely tender, enlarged right lobe of the liver could again be palpated. Some right upper quadrant pain and rigidity remained. On January 17, 1944, under local infiltration anesthesia a large bore needle was inserted in approximately the same location but no pus was obtained until the point of the needle, which was directed superiorly, medially, and posteriorly, had reached a depth of about 8 cm. A definite sense of resistance was met in going through the capsule of the abscess. Three hundred cc. of thick yellow pus with chocolate streaks in it were aspirated. Similar aspirations were done on the 20th and 25th of January, and on the 5th of February, and 450 cc., 550 cc., and 400 cc. of typical chocolate colored pus were obtained at each respective aspiration. A total of 1,850 cc. of pus was removed in these five aspirations and no ameba or bacteria were found in any of the specimens. At the time of the last aspiration the abscess was irrigated with 100 cc. of 2 per cent chiniofon solution through two needles. Anteroposterior and upright films of the abdomen taken after the fourth aspiration and a lateral film taken during the fifth aspiration showed a large fluid and air containing cavity within the substance of the right lobe of the liver. (Figs. 1, 2, and 3.) The cavity was located within the liver substance slightly medial to the midclavicular line and midway between the abdominal wall and the anterior margin of the vertebral bodies.

The patient received a total of 22 gr. (1.32 Gm.) of emetine hydrochloride intramuscularly; two courses of carbarsone, total 150 gr. (9.0 Gm.); and two courses of chiniofon, total 720 gr. (45 Gm.) over a period of about three months. The latter two drugs were given to allay any latent ameba present in the colon and rectum although none had been found in the stools. Up to the time of his discharge to military duty on July 12, 1944, the patient had had no recurrence of his abdominal symptoms and felt perfectly well. His weight was 158 pounds, the liver edge was not palpable, the sedimentation rate was 18 mm. per hour, the sigmoidoscopic examination was negative, and repeated stool examinations were normal.

COMMENT

From an epidemiological point of view it has been pointed out that amebic liver abscess occurs less frequently in temperate climates than in the tropics, although amebiasis may be common. Also, it is

FIG. 2. Upright roentgenogram taken after fourth aspiration showing a fluid level in the liver abscess.

known that amebic liver abscess is much more common among visitors than in natives of the tropics, approximately ten times more common in men than women, and that it rarely occurs in people below the age of twenty and seldom above the age of sixty. All these factors were unfavorable to our armed forces stationed in the tropics and it is reasonable to assume that the disease will be encountered more frequently as they return home. In this connection it is well to remember that although dysentery is not a necessary precursor, the majority of amebic liver abscesses develop within one to three months after the dysenteric manifestations. Some abscesses, however, do not become evident for several years thereafter and there are cases on record occurring many years later. In our case the liver abscess became evident sixteen months after the initial attack of dysentery and approximately five months after the amebic colitis had apparently been cured.

Characteristically, amebic liver abscesses are bacteriologically sterile, single, and usually occur in the right lobe of liver. In three collected series of cases, respectively,

Ochsner and DeBakey[4] found 85.1 per cent sterile, 65 per cent single, and in 84.7 per cent the right lobe was involved.

treated with aspiration and emetine. Ochsner and DeBakey,[4] in 1943, reported a mortality rate of 33.3 per cent in twenty-

Fig. 3. Lateral roentgenogram taken during the fifth aspiration on February 5, 1944, showing the needle in the abscess cavity.

These authors also found ameba in the abscess contents in 16.5 per cent of their own series of cases and in 37.8 per cent of a collected series of cases. The most frequent locations in the right lobe have been near the dome of the liver with consequent elevation of the right diaphragm, or less frequently near the inferior surface. The abscess in our case was located near the inferior margin of the liver with a downward enlargement of the liver and with no elevation of the diaphragm evident in the x-ray. Munk[2] has emphasized that in this location no diaphragmatic radiological signs can be expected.

It has repeatedly been shown that the mortality of amebic liver abscess is greatly increased with the onset of secondary infection, which in a few cases may be of hematogenous origin or, more commonly, introduced at the time of open drainage. The avoidance of secondary infection of the abscess is therefore most important and should influence the method of treatment. In spite of scrupulous precautions to avoid it, secondary infection invariably follows open drainage of an abscess which is relatively sterile. As early as 1922, Rogers[5] reported a decrease in mortality from 56.8 per cent in patients treated by open drainage to 14 per cent in those

four patients treated by transpleural drainage, 30.4 per cent in twenty-three treated by transperitoneal drainage, 10.5 per cent in nineteen treated by simple incision over the localized abscess, and 6.6 per cent in fifteen drained by the extraserous route. These authors also reported their experience with emetine and aspiration, and in a series of eighty-three cases the mortality rate was only 3.6 per cent. The results indicate that aspiration is the procedure of choice in the great majority of cases in which evacuation of the abscess becomes necessary. It is also important to recognize the distinct rôle of emetine hydrochloride in these cases. With amebic hepatitis or even where early abscess formation has occurred, emetine alone may suffice to effect resolution and when aspiration is contemplated the preliminary administration of emetine is obligatory. Two of the three patients who died in the series of eighty-three cases reported by Ochsner and DeBakey[4] failed to get emetine prior to aspiration, and the patient in the third fatal case received emetine but was not aspirated. The authors believed that a combination of both emetine and aspiration might have prevented these deaths.

As stated by Ochsner and DeBakey,[4]

"the complications of amebic hepatic abscess consist essentially of secondary infection with pyogenic organisms, direct extension or rupture of the abscess into one of the adjacent viscera or serous cavities, and thrombosis and embolism." Extension upward with consequent pleuropulmonary involvement occurs more frequently than peritoneal involvement due to the more frequent location of the abscess near the convex surface of the liver. In a collected series of 2,490 cases of amebic hepatic abscess Ochsner and DeBakey[4] found 15.8 per cent of cases with pleuropulmonary complications, whereas in a collected series of 1,095 cases these authors found the incidence of rupture into the peritoneal cavity to be 6 per cent.

From the clinical course in this case it is quite obvious that the chronic amebic liver abscess was not secondarily infected, and as it approached the surface of the liver by gradual extension, adhesions formed as a result of peritoneal reaction, and when the rupture occurred the abscess was quite limited by the adhesions. The generalized abdominal tenderness, rigidity, and vomiting which developed shortly after admission and receded rapidly after the first aspiration probably indicated a slight leakage into the general peritoneal cavity. The progress in this case indicates that in certain selective instances in which the complication of a localized extension of an amebic liver abscess without secondary infection is present either near the lower margin of the liver or in the subdiaphragmatic region, the use of emetine and aspiration is quite likely to be successful and can be accomplished with less danger to the patient than open drainage by an extraserous approach. Where the amebic abscess has become secondarily infected, the practice has usually been to perform open drainage by an extraserous approach. However, two recent case reports of secondarily infected amebic liver abscesses in which the sulfonamides and penicillin were successfully used give promise of even a wider range of usage of the conservative treatment. Alport and Ghaliougui[1] report the recovery of a patient with an amebic liver abscess secondarily infected with Bacillus pyocyaneus who was treated with repeated aspirations and the local and systemic use of sulfonamides. Noth and Hirshfeld[3] reported the successful use of penicillin in a case secondarily infected with betahemolytic streptococci. They inserted a small ureteral catheter into the abscess cavity through a large bore aspirating needle. The needle was then withdrawn and penicillin was injected periodically through the catheter into the abscess. The patient received a total of 830,000 units of penicillin over a period of fifteen days by this method and a cure resulted.

SUMMARY

The case reported is that of a chronic amebic liver abscess which was complicated by rupture and the formation of a localized intraperitoneal abscess with probable slight leakage into the general peritoneal cavity. Conservative treatment with emetine hydrochloride and multiple aspirations proved successful. The liver abscess manifested itself sixteen months after the initial attack of dysentery in India and approximately five months after the amebic colitis had apparently been cured.

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GRANULOMA INGUINALE (VENEREUM) OF UTERUS*

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THE first case of granuloma inguinale (venereum) of the uterus and adnexae ever to be reported was described by Pund and Gotcher[1] in 1938. Since then three additional cases have been reported by Pund and Mc Innes[2] and Pund and Auerbach.[3] In each of these instances the body of the uterus was secondarily involved by extension from a lesion in the cervix. Granuloma inguinale of the cervix, previously a disregarded entity, was first recognized by Pund and Greenblatt[4] as a specific lesion, and because the lesions were found at sites other than the inguinal region, the authors recommended that the name of the disease be changed from granuloma inguinale to granuloma venereum. However, to avoid confusion with lymphogranuloma venereum, it was deemed advisable to retain the old terminology of granuloma inguinale for the disease at present under discussion.

Ever since our own corroboration[5] of Pund and Greenblatt's[6] contention that the Donovan bodies can be readily observed in routine tissue sections stained with Delafield's hematoxylin and eosin, we have been able to diagnose granuloma inguinale with much greater ease than heretofore, and we suspect that in the past we have been overlooking instances of granuloma inguinale, mistaking them for non-specific granuloma. It is our opinion, one also shared by Dr. Pund,[7] that granuloma inguinale of the female internal genitalia, is a much more common disease than would appear from the paucity of cases reported in the literature. It is our contention that as soon as the pathologist realizes the relative ease with which the Donovan bodies can be recognized in routine tissue examinations, the profession will undoubtedly find that granuloma inguinale of the female internal genitalia is much more prevalent than has been supposed hitherto. This fact cannot be stressed too much for the easier recognition of this disease and it is with this purpose in mind that the following case of granuloma inguinale of the uterus, the fifth case to be described in the literature to date, is reported here.

CASE REPORT

A. H., a fifty year old, colored female, was admitted to Cumberland Hospital on February 5, 1945, complaining of vaginal bleeding and pain in the right lower quadrant of three months' duration. The patient had lost fifty pounds in weight during the interval, and prior to admission the pain had increased markedly in intensity.

The patient had an appendectomy fourteen years previously. Her menses appeared at the age of fourteen and she experienced her menopause seven years prior to admission at the age of forty-three. Her menstrual flow had been regular, recurring every twenty-eight days, occasionally accompanied by slight dysmenorrhea. The patient had had three previous normal pregnancies. No history of abortions or miscarriages was obtained. The patient denied having been exposed to any venereal disease. A systemic review of symptoms was essentially negative.

Physical examination at the time of admission revealed a pallid, colored female who appeared older than the stated age. Her temperature was 102.6°F., pulse 100, respirations 20 per minute. The head, neck and chest were entirely normal. The abdomen was round and revealed a healed midline suprapubic scar. A firm nodular mass was palpable, rising out of the pelvis to a point 5 cm. above the symphysis

pubis. This mass seemed intimately attached to the suprapubic scar. The abdomen was slightly tender in the region of the palpable mass. The inguinal nodes were not palpable nor was there any skin lesion noted. Pelvic examination showed a multiparous introitus. The cervix was firm, and edematous. A shallow ulcer measuring 3 mm. in greatest dimension was noted on the anterior lip of the cervix. A copious, foul-smelling, sanguineo-purulent discharge was present in the vagina. The uterus was enlarged and nodular and seemed to be associated with the mass palpated through the abdominal wall. The adnexae could not be clearly identified. Rectal examination failed to reveal any intrinsic masses. A proctoscopic examination failed to reveal any abnormalities.

Laboratory data were as follows: Red blood cells, 2,500,000 per c.mm., hemoglobin 50 per cent; white blood cells 10,000; differential: polymorphonuclears 63 per cent; stabs 3 per cent; lymphocytes 31 per cent; monocytes 3 per cent; Wassermann test 4 plus; Kline test positive; urine: sugar, negative; a trace of albumin; microscopic—8 to 10 white blood cells; occasional red blood cells.

A chest x-ray revealed no pulmonary abnormalities. Radiographic examination of the heart suggested the presence of an aortitis. A flat plate of the abdomen failed to reveal any soft tissue mass.

The patient was placed on a course of sulfadiazine therapy. However, the temperature failed to return to normal, rising almost daily to 101°F. She received daily vaginal douches and within a period of two weeks, the foul smelling sanguineo-purulent discharge decreased to a considerable extent. The profound anemia was corrected by means of transfusions and on March 2, 1945, the patient was taken to the operating room for a celiotomy.

The abdomen was explored through a suprapubic midline incision. Numerous adhesions were encountered in the lower abdominal cavity. The uterus was enlarged and nodular and adherent to the bladder, anterior parietal peritoneum, and adjacent sigmoid colon. A supracervical hysterectomy and right salpingo-oophorectomy were performed. The left tube and ovary were absent. Apparently they had been removed at the time of the previous operation.

The pathological report on surgical specimens is as follows:

Macroscopic: Specimen is a uterus with attached right ovary. The uterus measures about 10 cm. in greatest dimension. Its shape is dis-
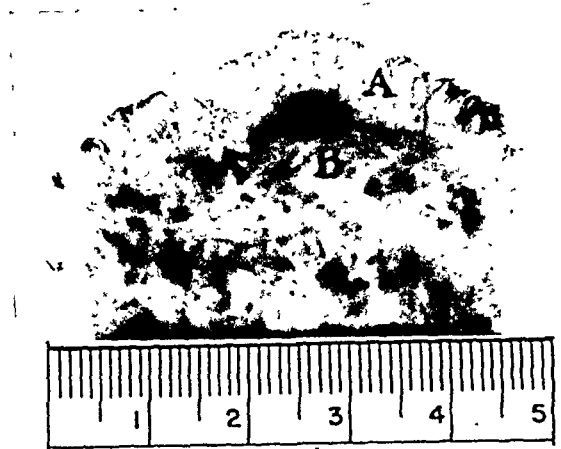
Fig. 1. Cross section through uterine wall. Note the thickened shaggy endometrium (A) with its irregular, poorly defined line of demarcation from the myometrium (B). Arrow points to a characteristic granulomatous nodule in the deeper layers of endometrium which is invading the myometrium, resembling a malignant process.

torted by multiple intramural and subserous fibroids. The endometrial cavity is enlarged, measuring about 8 cm. in greatest diameter. The endometrium is irregularly thickened, shaggy and of a gray-green discoloration. Its surface resembles a pyogenic membrane. The cut section shows an irregular line of demarcation between the myometrium, and endometrium, the latter dipping into the myometrium, in areas to a depth of about 6 mm. At the myometrial junction the endometrium becomes firmer and finely nodular, resembling a granuloma or malignancy. (Fig. 1.)

The attached ovary is about 3.8 cm. in greatest dimension, firm and gray in color. Cut section shows occasional follicular cysts in the cortex of the organ.

Accompanying the specimen there are two discrete, ovoid, firm gray masses, the larger measuring about 2 cm. in greatest dimension. Sections of these show smooth, yellow-gray cut surfaces.

Microscopic: The endometrium is represented by a thick layer of granulation tissue, the superficial portion of which is essentially pyogenic membrane. Most of the endometrial glands have been replaced by an inflammatory infiltrate with a rich network of newly formed capillaries. The predominating cell of the

infiltrate in the superficial portion of the membrane is polynuclear. The latter, however, are almost completely replaced by plasma cells as the myometrium is approached. Here, all of the infiltrating cells are of the plasma variety. They extend into the underlying myometrium in cords and solid sheets, so that in some sections the lesion assumes the appearance of a plasma cell neoplasm. However, the true nature of the inflammatory process is disclosed in the vascular reaction, as well as in the polynuclear infiltrate described above. Throughout the entire endometrium there are also present numerous macrophages which vary in size from about 15 to nearly 100 microns in diameter. These are found irregularly scattered among the inflammatory cells, many of them containing several nuclei. Although they are giant in size, they are neither of the Langhans type nor of the usual foreign body variety. Their true identity is disclosed by the presence of intracytoplasmic vacuoles containing one or multiple structures which answer the description of Donovan bodies. (Fig. 2.) The latter are often better discernable with the Giemsa stain than with the routine hemotoxylin and eosin, although they can be recognized with the latter preparations. With silver stains the macrophages are observed to be heavily laden with black granules which at times become difficult to differentiate from nuclear débris. Gram stains, while showing the vacuoles in the cytoplasm of the cells, fail to show the organisms distinctly.

The fibroids show hyalin changes in the fibromyomatous tissue. Careful search for the Donovan bodies fails to disclose them here, although it at times becomes difficult to determine whether the nuclear granules of degenerated fibroblasts are not encysted Donovan bodies. However, there are no demonstrable areas of inflammatory infiltrate in which the characteristic macrophages could be expected, as in the granulation tissue of the endometrium described above.

The ovary shows fibrosis of the parenchyma and occasional follicular cysts. The parovarian tissue, while containing foci of inflammatory infiltrate, does not show any of the Donovan bodies.

Diagnosis: (1) Granuloma inguinale (venereum) uteri; (2) fibromyomas of uterus and broad ligament; (3) fibrosis and follicular cysts of ovary: utero-ovarian adhesions, fibrous.

The operative wound healed by primary union within seven days after operation and her postoperative course was uncomplicated except for the continued daily rise in temperature to about 101°F., which had preceded the operation. This continued for about thirty-four days until tartar emetic therapy was instituted. She received 2 to 4 cc. of 1 per cent solution of the drug intravenously every other day. Concomitantly, the temperature dropped to normal and remained normal until she was discharged much improved on April 15, 1945. Due to the fact that the vaginal discharge persisted, she was referred to the out-patient clinic for further observation and treatment, although her general condition remained very satisfactory.

Upon finding the Donovan bodies in the endometrium, the cervical ulcer was re-examined as a possible primary source for the uterine infection. Smears were made directly from the ulcer and from the exudate expressed from the pieces of the cervical biopsy which was performed at the same time. The pathological report on the findings follow:

Macroscopic: Specimen consists of five irregular pieces of soft gray-pink tissue, the largest measuring about 3 mm. in greatest dimension.

Microscopic: The tissue is cervix including squamous lining of cervical lip. The latter shows ulceration with replacement of the lining by a type of granulation tissue similar to that described in the uterus. There are many of the pathognomonic cells of Pund demonstrable in all fields of every section examined. These cells contain the Donovan bodies in abundance. (Fig. 3.)

Wright stains of smears made from the exudate expressed from pieces of cervix show large numbers of Donovan bodies. Many of them lie within Pund cells while others are extracellular. The characteristic "safety pin" forms are found singly or in groups. (Fig. 4.) Cyst forms separated from their host cells are also present in abundance. Among the cells constituting the exudate are found large numbers of eosinophiles as well as plasma cells.

The organisms are also readily demonstrable in smears of the exudate stained by Giemsa, silver, and hemotoxylin and eosin methods. The gram stains, while showing the vacuoles within the cytoplasm of the Pund cells, stain the organism only faintly, when they stain them at all.

Diagnosis: Granuloma inguinale of cervix.
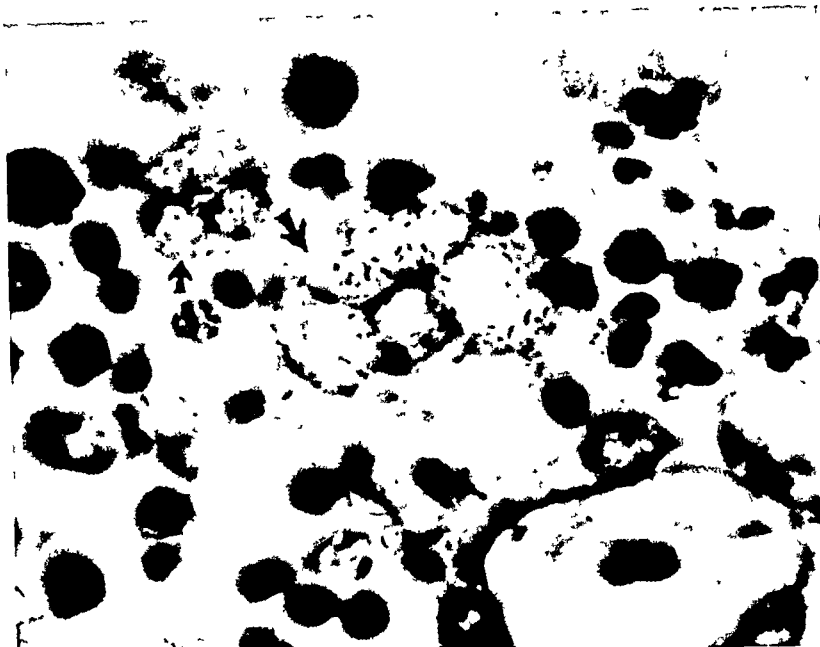
Fig. 2.
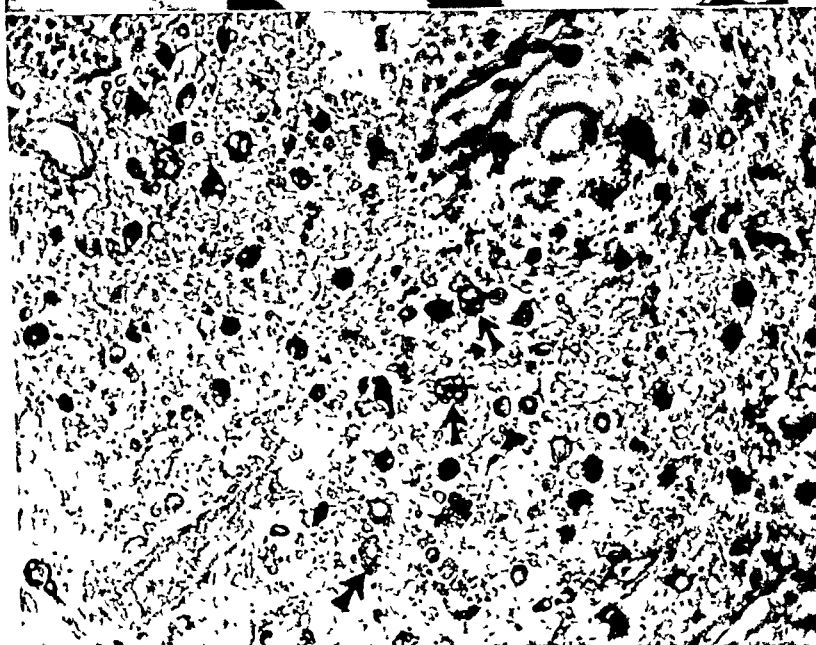
Fig. 3.

Fig. 2. High power magnification of a Giemsa stain of a characteristic area in the endometrium showing Pund cells (arrows) each containing several intracytoplasmic cysts filled with Donovan bodies. Similar fields were also observed with hematoxylin and eosin sections. Note the characteristic concentration of the Donovan bodies in the periphery of the cysts. Note also the relatively large size of the central Pund cell (about 100 microns in diameter) as compared to the average plasma cell shown in the infiltrate surrounding the Pund cell. (2,000 X)

Fig. 3. Silver stain of the biopsy from the ulcer of the cervix showing Pund cells (arrows) containing encysted Donovan bodies. Note the great abundance of these cells in one field. (400 X)

Having found the Donovan bodies so readily
n the smears of the cervical ulcer, similar
preparations were then made of the vaginal

To be complete in the clinical study of the
case, there remained but one other confirma-
tory test to be performed, although the diag-

FIG. 4.
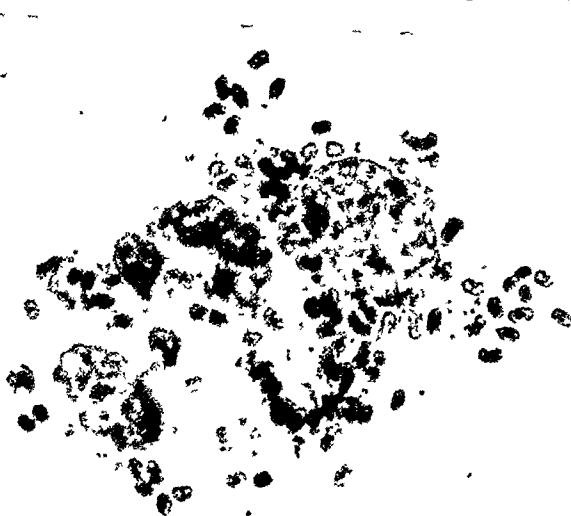
FIG. 5.
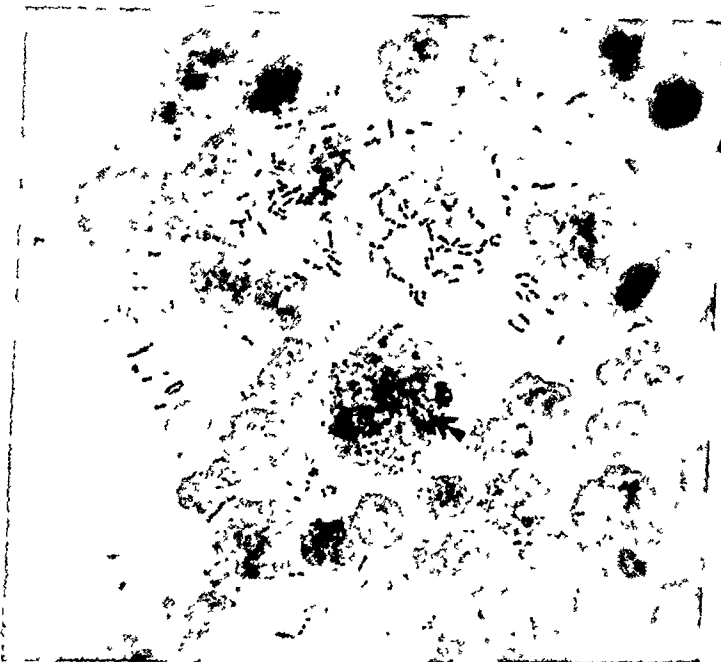
FIG. 4. Wright stain of exudate expressed from tissue removed from
ulcer of cervix. Note the individual intra- and extracellular
Donovan bodies, including numerous "safety pin" forms. The
large oval nucleus is from the Pund cell the cytoplasm of which
is scarcely visible. (2,000 X)

FIG. 5. Wright stain of the vaginal discharge. Arrow points to intra-
cytoplasmic Donovan bodies within a Pund cell. The other organ-
isms scattered about are bacteria. (2,000 X)

discharge. The results were almost as satis-
factory as were those described for the smears
of the cervix. The Donovan bodies were found
in abundance although less distinctly within
degenerated Pund cells, amidst inflammatory
exudate together with the usual bacteria of
vaginal flora. (Fig. 5.)

nosis had already been fully established by the
demonstration of the organisms and the charac-
teristic histological changes observed in the
ulcer of the cervix and uterine endometrium.
This was the skin test for granuloma inguinale
recently introduced by Dr. Borris A. Korn-
blith. This test was performed by Dr. Korn-

blith himself and proved to be strongly positive.*

COMMENT

The true nature of the condition in this case was not suspected by the clinician or the pathologist who examined the organs grossly, until the routine microscopic examination of the tissue sections had been made. The hidden, deep-seated location of the ulcer, the absence of any inguinal skin lesions, the close resemblance of the gross changes in the uterus to those of malignancy, and finally the positive serology pointing to the possibility of a specific granuloma, all were factors which militated against a correct diagnosis in this instance, as was probably also true in previously undiagnosed cases.

However, after finding the Donovan bodies in the endometrium, a search was made for them in the ulcer of the cervix. It was here that the organisms were found in greatest abundance and in their most characteristic morphology. This led to the successful search for the Donovan bodies in the smears of the vaginal discharge, where they are rarely sought, yet where they were found with ease and in surprising abundance in this case.

The strongly positive skin test is deserving of special consideration here. This test should prove to be of great aid in the clinical diagnosis of granuloma inguinale where the Donovan bodies cannot be readily demonstrated. The test is performed by the intradermal injection of an antigen prepared by Kornblith from the tissue of a lesion of granuloma inguinale.[8,9] The histopathology of the intradermal reaction was studied by Dr. Sadao Otani who described a characteristic epithelioid nodule or sphere, without any acute inflammatory reaction and a conspicuous absence of polymorphonuclear cells. Since similar histologic changes are found in the pure lesion of granuloma inguinale, uncomplicated by the secondary infection

* We are indebted to Dr. B. A. Kornblith and Dr. Sadao Otani for their interest and aid in the study of this case.

which usually supervenes to obscure it, the skin test has been accepted by its author as a confirmatory test of granuloma inguinale.

CONCLUSIONS

1. The fifth case of granuloma inguinale (venereum) of the uterus, secondary to infection of the cervix is reported and the literature is reviewed. The authors are of the opinion that granuloma inguinale of the internal female genitalia is much more common than has been supposed.

2. Attention is again called to the ease with which the Donovan bodies may be found in routine hemotoxylm and eosin sections of the involved organs. (This was first pointed out by Professor Pund.) Greater realization of this fact should lead to the correct diagnosis in many cases of granuloma inguinale which are at present being overlooked and diagnosed as nonspecific granulomas.

3. The value of the skin test as an aid in the diagnosis of this disease is discussed.

4. Search for the Donovan bodies in smears from the vaginal discharge is recommended in suspected cases of granuloma inguinale, as an adjuvant method of identification of the organism.

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REGIONAL ILEITIS

REPORT OF AN ASYMPTOMATIC LETHAL CASE

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INSUFFICIENT time has elapsed since Crohn and his co-workers[1] described the affection known as regional or segmental ileitis for its establishment on a definite pathologic basis. While in the twelve years following the first publication there has been no dearth of contributions on this affection, neither clinicians or researchers have found the etiologic factor, nor is there uniformity in the descriptions of the pathologic processes associated with the affection properly diagnosed after surgical intervention.

For this reason the report of a case, in which the patient though apparently successfully operated upon, terminated in death may offer some interesting data.

CASE REPORT

An Italian woman (Hospital No. 62371), aged fifty-two, was referred to my service at Edgewater Hospital June 15, 1944, with her family physician's tentative diagnosis of abdominal tumor.

During the past year she had lost approximately thirty pounds and for the past eight months had noticed foul, mushy and foamy stools with the feces being light yellow colored. Two weeks prior to admission she began to suffer from chills and fever, and only a week ago did she have nausea and vomiting. In spite of these symptoms she had never been compelled to remain in bed and had attended to her household duties to the very minute she left for the hospital. She herself discovered a mass in the right lower quadrant of the abdomen and observed its increase in size, but the mass had at no time caused her any distress. Except for pneumonia three years ago she had had no illness of any kind. Her climacteric dates back to about the time of the attack of pneumonia.

The patient's mother died of pneumonia at the age of seventy-six. Her father succumbed to the same disease at the age of fifty-nine.

One brother is said to have died of pulmonary tuberculosis. The other familial data are negative in nature.

The dark complexioned and dark skinned woman was fairly well nourished in spite of her loss in weight. Examination of the head and neck revealed no abnormality. Auscultation and percussion of the chest gave normal resonant tones, nor was there any evidence of bronchitis. The heart proved normal, her pulse rate was 84, and the mercury manometer showed her blood pressure to be 100/70.

The abdominal wall was soft and the liver and kidneys were not palpable. A hard mass in the right quadrant the size of a large grapefruit and nodular to the feel, extended downward into the pelvis and upward to the right lower margin of the chest. The mass could be moved laterally with some difficulty. There was a small inguinal hernia on the right side, which the patient attributed to an accident.

Neuromuscular tests especially of the lower extremities yielded normal conditions.

The urine had a specific gravity of 1.016, and an acid reaction and was free of sugar and albumin. Microscopically only a few pus cells were seen, but no casts. The blood count showed 3,340,000 erythrocytes and 8,850 leukocytes, with 26 per cent lymphocytes and 74 per cent polymorphocytes. The hemoglobin was reduced to 48 per cent. The feces were light yellow in color, and a slightly positive reaction to the blood test but were wholly free of parasites and ova. Serologic examination (Kahn test) proved negative.

Radiologic examination revealed the esophagus to be normal. The stomach filled readily and manifested neither defect nor retention. The duodenal cap was normal. The upper jejunum presented a large area of barium which did not correspond to the contour of the viscus. (Fig. 1.) A colon barium enema revealed neither obstruction nor defect in the gut proper. The mass was palpable in the region of the cecum. The distal ileum was

not properly visualized and appeared to have defects. Some air was seen in the small intestine. There was a pocket in the right middle quad-

the cecum, the transverse colon and several loops of the ileum.

A most careful attempt was made to free
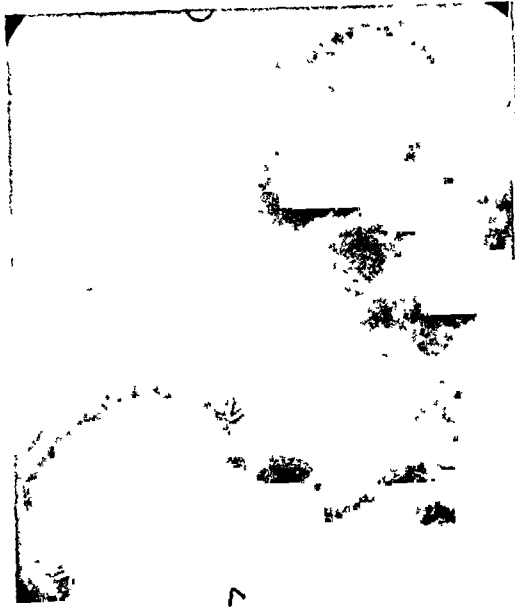
FIG. 1. X-ray of ileocecal region.

FIG. 2. X-ray showing defect in distal part of ileum.

rant corresponding to the large area of barium in the upper jejunum. Films taken four and six hours after the ingestion of the barium revealed the same pocket above the cecum. No appreciable obstruction could be detected. Another barium enema revealed a defect near the distal part of the ileum. (Fig. 2.)

Immediately after the completion of the physical examination the case was diagnosed as regional ileitis with involvement of the ascending colon. The x-ray diagnosis was confirmatory but also necessitated the addition of perforation of the ileum or possibly of the lower jejunum, plus pocket formation.

The preoperative care consisted of two blood transfusions and appropriate doses of sulfasuxidine administered orally in addition to the usual routine measures to get the patient in the best possible somatic state.

Laparotomy under spinal analgesia augmented by the intravenous administration of pentothal sodium was performed on June 24th, nine days after the patient's admission to the hospital. After exposure of the peritoneal cavity the large mass estimated to be 15 cm. in its diameters was found to be firmly adherent to the ascending colon and involving

the mass from the ascending colon since the radiologic examination had clearly shown that the mucosa of the colon was not involved, but in spite of the gentlest possible manipulation the cavity of the mass was opened and permitted the escape of purulent material and undigested food particles upon the protective gauze packs. The mass which was partly formed by the serosa of the colon was completely covered by omentum. The entire mass with the terminal ileum, the appendix, the ascending and part of the transverse colon together with the involved loops of the ileum was removed in toto. (Figs. 3, 4 and 5.)

After end-to-end anastomosis of the two upper loops of the ileum, its terminal part was closed, as was the resected transverse colon. Lateral ileocolostomy by the usual technic concluded the operation proper. Ten Gm. of sulphathiazole was sprinkled into the abdominal cavity and the abdomen closed in layers over a small drain.

Upon being returned to her bed the patient was given 2,000 cc. of 5 per cent glucose in normal saline solution intravenously. This was followed by general pulmonary edema. Her extremities also became edematous. Cy-

FIG. 3.
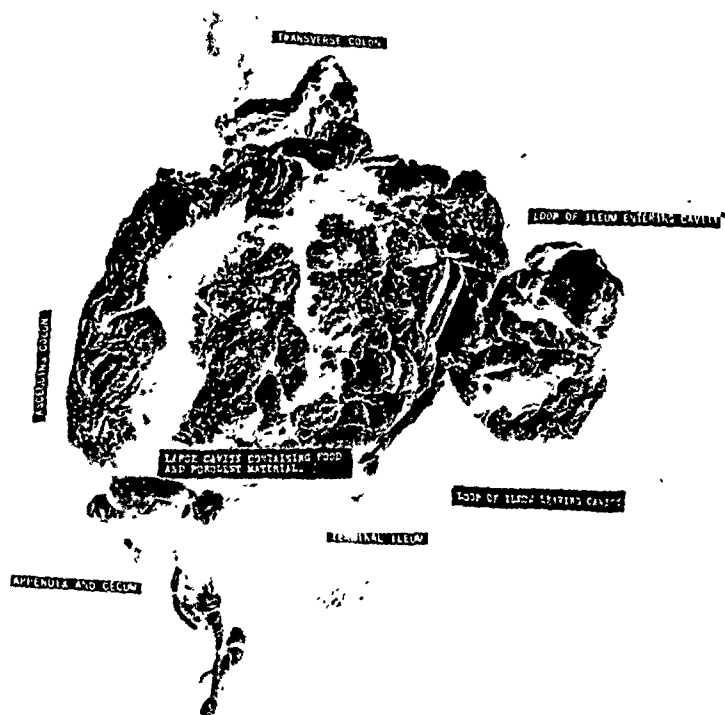
FIG. 4.
For legends see opposite page.

anosis developed necessitating the administration of oxygen and the restriction of fluid intake. The day after the operation the patient

was not obtained. Subsequently she appeared to improve at least while she remained under the oxygen tent. Her pulse at that time never

FIG. 5.
FIGS. 3, 4 AND 5. Views of mass which was removed in *toto*.

was given 500 cc. of plasma. Later 1,000 cc. of amino acids in dextrose was administered.

In spite of these measures the cyanosis did not abate. Examination of the chest revealed râles and bronchial breathing over the right lower lung. An x-ray taken with a portable apparatus showed elevation of the right diaphragm, pulmonary atelectasis and incipient pneumonia of the right lower lobe. (Fig. 6.)

Breathing exercises were initiated and 150,-000 units of penicillin was given daily. Coramine, caffein sodium benzoate were additional agents used as indicated. The patient was constantly under the oxygen tent. Fluids were introduced parenterally.

On the fourth postoperative day the patient's condition was regarded as unimproved and bronchoscopic aspiration seemed to be indicated. This procedure revealed edema and mucus of the right bronchus, but a "plug"

exceeded 100, her temperature never rose above 100°F. and her blood pressure registered 110/80.

Reduction of the supply of oxygen resulted in cyanosis and dyspnea. Alarming symptoms of anoxemia (spasms of the fingers, delirium) necessitated correction of the deficient aeration by increasing the dosage of oxygen, but in spite of it the patient never was quite free of the cyanosis.

Owing to slight drainage of the wound and to the high position of the right diaphragm the possibility of the presence of a subphrenic abscess suggested itself. One also had to pose the question whether or not the collapse of the right lung and the pneumonia were secondary to an intra-abdominal pathologic process. Accordingly, a diagnostic puncture below the ninth rib was carried out. Since it yielded only a negative result the diagnosis of

atelectasis and pneumonia shown in the x-ray as well as clinically was now clinched.

Although the patient was able to take

FIG. 6. X-ray showing pulmonary atelectasis of right lower lobe.

nourishment by mouth the postoperative course progressed without a tangible change. On the fourteenth postoperative day her temperature suddenly rose to 104°F., the pulse rate increased to 130 with a corresponding increase of the rate of respiration, her fingers became more markedly cyanotic and death ensued rapidly.

The specimen removed by operation consisted of a large mass 7 by 15 cm., whose structure mainly was a cavity filled with partly digested peas, celery and vegetable fibers. The cavity whose diameter reached 13 cm. had a wall which in some parts attained a thickness of 8 mm. Its inner surface was rough and formed numerous granulomatous growths some of which had the size of 1 cm. Some areas were covered by fibrinopurulent material.

Attached to and emptying into the cavity was a portion of the ileum, 11 cm. in length, the communication at one point being through two fistulous openings. Another part of the ileum, 7 cm. in length, terminated directly into the cavity. The terminal ileum, 20 cm. in length, the cecum and the ascending colon were firmly adherent to the wall of the mass. That part of the ileum which was adjacent to the fistulous openings showed a slight degree of thickening. The part of the ileum

which terminated directly into the cavity had its lumen continuous with the large abscess cavity. (Figs. 3, 4 and 5.)

Histologically, the wall of the abscess cavity consisted of fibrous and fibrinous tissue, studded with round cells and polymorphonuclear leukocytes. Most of the mucosa of the gut was destroyed and replaced by densely packed round cells at one point, while the remainder of the intestine was free of any pathologic involvement.

The pathologic diagnosis was: (1) chronic abscess cavity with fistulous openings into two portions of the ileum; (2) chronic regional enteritis.

Necropsy was performed soon after the patient's death and confirmed the clinical diagnosis of atelectasis and pneumonia of the right lower lung, so that the elevation of the right diaphragm was attributable to that lung condition. There was neither a subphrenic nor an abdominal abscess. The remaining lung was somewhat edematous but otherwise normal. The right heart was slightly enlarged. A localized area of peritonitis was noted at the site of the ileocolostomy, but there was no evidence of generalized peritonitis. The anastomosis was complete and intact except for a negligible leakage, which undoubtedly must be attributed to the efforts of the patient to clear her lungs of mucus by coughing.

COMMENTS

In a previous communication[2] I presented three cases of regional ileitis in which the patients were successfully operated upon. In that article I reviewed the status of our knowledge of this malady and published certain conclusions which were in the main in accord with concepts held by a number of competent surgeons.

The case here reported again shows that it is hardly correct to speak of regional ileitis as a clinical entity only, as has been proposed by a number of observers. In the light of the history of my case it seems clear there can be no thought of a "clinical entity" and that one is justified in referring to this affection as a pathologic entity.

The case under consideration shows that the patient at no time had any symptoms justifying a diagnosis of regional ileitis and

in fact was able to perform her duties as a wife up to the minute she left her house to enter the hospital. One can readily see that this case was virtually asymptomatic throughout the course, so much so that the preoperative diagnosis of regional ileitis was made principally on the basis of the presence of a right abdominal mass, which it will be recalled, had caused the patient no distress. This in turn suggests the question how it was possible for the extensive process to have progressed for a considerable time without giving rise to symptoms pointing to the site if not the nature of the affection. The answer to this must be sought partly in the chronicity of the pathologic process and partly in the fact discovered at operation, that leakage from the intestine had been prevented by the protective wall thrown around the mass by the omentum.

It is generally conceded that the etiologic factor of regional ileitis is still unknown. The most careful laboratory studies have so far failed to establish a causative micro-organism. The Mayo Clinic[3] has tentatively suggested that a filtrable virus may be the responsible agent. After most careful investigation Keith Rose[4] isolated a coliform bacillus without, however, being able to demonstrate it as the causative organism. The same holds good for the claim by several authors that the Streptococcus viridans should be held responsible for the affection.

Our own investigations have proved equally fruitless. Nevertheless, I am inclined to advance the theory that we have to deal with a type of infection resembling that of tuberculosis. This is by no means based on the circumstance that a brother of the patient had died of pulmonary tuberculosis, because we have been unable to establish a familial relationship of tuberculosis to any form of regional ileitis. The theory is advanced rather on the pathologic study of the specimen obtained by the operation which clearly shows thickening of the walls of the abscess cavity of a granulomatous character. Add to this the circumstance that in several areas the gut has been destroyed and replaced by densely packed round cells in at least one section, and the similarity with a tuberculous process almost suggests itself.

I shall not enter here into the problem of why the patient at no time experienced any distress from the mass except to pose and answer the question why there were no symptoms of obstruction which naturally would have compelled the patient to seek medical aid much earlier. It is my conviction that both loops had perforated almost simultaneously; because if only one loop had undergone such injury and this without an exit for its contents, there would have developed sufficient distention of the cavity to give the patient uneasiness if not grave distress. The asymptomatic course clearly shows the synchronicity of the two perforations, to which should be added the radiologic and pathologic evidence that each loop remained in more or less direct contact with the cavity so that there never was any hindrance to the flow of intestional contents. Since the lumen of the colon was not involved, natural defecation could take place throughout the duration of the disease.

Of perhaps greater interest is the question of therapy. The fact that an extensive resection of the intestinal tract was carried out naturally raises the question whether a less radical operation would have prevented the lethal issue. Perusal of the literature leads us into a maze of opinions from which it is rather difficult to extricate oneself. There have been some claims that simple appendectomy has brought about a cure. Others report favorable results from ileocolostomy and therefore exclusion of the affected gut. The Mikulicz type of operation has been suggested and carried out in the hope that it would prove a relatively safe procedure. There is no dearth of claims that even no operative intervention at all has been followed by spontaneous cures.

When one sifts the available material in the literature one must conclude that no

type of operation, conservative or radical, has given assurance against recurrences and no doubt many of the so-called cures would have been subjected to critical analysis. On the other hand deaths have been reported from every type of operation not excepting that of Mikulicz.

In my cases it should be taken into consideration that the patient was in good physical condition except for the reduced hemoglobin percentage which, however, was corrected by the two blood transfusions. The operation of radical removal of the affected parts of the ileum and colon was decided after exposure of the peritoneal cavity because it became evident at once that simple ileocolostomy would have been a wholly inadequate measure. That the Mikulicz type of operations may in suitable cases prove a relatively safer procedure is not denied. Certainly in our case every known measure has been resorted to for the preoperative preparation of the patient. While it may be held that the insignificant leakage from the ileocolostomy which appeared on the seventh postoperative day and undoubtedly was produced by the patient's efforts to cough up her pulmonary secretion may have added to the toxemia and the pulmonary complication, it should be taken into consideration that the edema and atelectasis took place almost immediately after the completion of the operation, that is after the introduction of the usual glucose solution.

There is no denying the relation of the operation to the development of the lung condition which led to death. It is not at all unlikely that in spite of our failure to detect any pathologic process in the lung by the usual physical examination, her pneumonia of three years ago had left a locus minoris resistentiae which needed only the trauma of the surgical intervention to become overwhelmed by toxic agents.

In conclusion, I wish to point out that possibly the hope of curing regional ileitis lies in non-surgical therapy. I have purposely mentioned the administration of sulfasuxidine in connection with the preoperative care. This preparation possesses bacteriostatic properties which in a number of cases have produced virtually sterile wounds and odorless feces after extensive intestinal operations. It is not unreasonable to hope that in the not too distant future chemotherapy will remove regional ileitis from the domain of the surgeon to that of the internist.

SUMMARY

1. A case of regional ileitis is presented which in spite of extensive pathologic involvement of the distal ileum, serosa of the cecum, ascending and part of the transverse colon had run a virtually asymtomatic course.

2. The preoperative diagnosis was possible mainly through the presence of a large nodular mass in the right side extending upward to the diaphragm and downward to the pelvis.

3. After adequate preoperative care the entire mass with the affected parts of the large and small intestine was removed in toto and the operation was completed by ileocolostomy and enterostomy.

4. The convalescence was stormy from the very beginning. In spite of the usual measures and the administration of penicillin in liberal doses the patient succumbed fourteen days after the operation from right lobar pneumonia, atelectasis and toxemia.

5. The problem of treating the affection by more conservative operative procedures is weighed and hope is expressed that chemotherapy may yet afford us means of combating this pathologic entity without resort to surgery.

SUPPLEMENTARY REPORT

Since the above article was written I have had three additional cases of regional ileitis under my care. All three patients were adults and afflicted with the chronic type of the disease. In two the diagnosis was made both clinically and roentgenologically, while in the third the diagnosis was established on a purely clinical basis.

These three cases add food for thought. In the first two we contented ourselves with the relatively simple operation of short-circuiting the normal part of the ileum to the transverse colon. In these two patients penicillin and sulfasuxadine were administered both pre-operatively and postoperatively. Both made excellent recoveries.

In the third case reliance was had solely on the administration of penicillin and sulfa-suxadine, and this patient, too, made a satisfactory clinical recovery.

Admittedly not enough time has elapsed properly to evaluate the permanency of the recoveries, but the rather prolonged freedom from recurrence offers at least a modicum of evidence that recoveries take place by either operative or chemotherapeutic management. We must, therefore, hold all therapeutic problems of regional ileitis sub judice until extensive experience, research and clinical observation will enable us to determine upon a rational therapeusis. Certainly the three cases here reported seem to substantiate the thesis advanced in the body of the above contribution.

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In early cases of peritonitis, if the focus of infection be removed the abdomen often can be safely closed without drainage. The capability of the peritoneum to overcome a certain amount of infection is truly remarkable.

From "A Short Practice of Surgery" by Hamilton Bailey and R. J. McNeill Love (H. K. Lewis & Co. Ltd.).

CARCINOID TUMOR OF THE APPENDIX PRODUCING A MUCOCELE

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CARCINOID tumors of the appendix occur in about 1 per cent of the appendices examined microscopically

FIG. 1. Specimen consists of an appendix which is kinked, tortuous and nodular. It measures 12 cm. in length and the distal three-fifths is distended and filled with thick tenacious mucus; here the appendix measures 5 by 3 by 3 cm. Proximally the diameter varies between 3 and 4 mm. Here the lumen is obliterated and the wall of the appendix is of a uniformly yellowish color.

Mucoceles of the appendix are found in less than 0.2 per cent of the cases of appendicitis. After carefully reviewing the literature, we have been unable to find a single case report of a carcinoid tumor of the appendix producing a mucocele. There is herewith presented such a case which is interesting both from a clinical as well as from a pathological point of view.

CASE REPORT

A. C., a white female, single, twenty-five years of age, gave a history of having had peri-umbilical pain for the past four days. This was followed by a bout of nausea and vomiting and then the pain became localized in the right lower quadrant of the abdomen. Pain persisted and grew more intense and the patient was brought to the hospital by her family physician. Her menstrual history was normal (13 × 28 × 3 days); there was no dysmenorrhea or metrorrhagia and her past history was irrelevant.

Examination of the abdomen revealed evidences of muscle guarding in the right lower quadrant of the abdomen. A definite oval mass could be palpated and this was interpreted as omentum wrapped around an inflamed appendix. There was deep and rebound tenderness as well as an area of hyperesthesia over McBurney's point. Her blood count was 10,200 white blood cells, 85 per cent polymorphonuclears. The temperature was 100.5°F. and pulse was 90. Our impression was that the patient was suffering from a suppurative or gangrenous appendicitis with omentum wrapped around the appendix. Immediate laparotomy was advised.

Through a lower right rectus incision the cecum was delivered. Attached to and accompanying the cecum was a mass about the size of a lemon. The mass was narrowed at the base and a clamp was applied to the base of the cecum. The meso-appendix was transfixed and tied with plain catgut and cut. The base of the appendix was tied with No. 2 chromic catgut. The base of the appendix was cut by means of a carbolized knife and the stump inverted. The cecum was dropped back into the abdomen and the incision closed in layers.

The postoperative course was uneventful; temperature ranged between 101°F. and normal. The patient was discharged on the tenth postoperative day. A six-week follow-up failed to reveal any unusual complications.

The pathological report was as follows: Specimen consists of an appendix which is kinked, tortuous and nodular. It measures 12 cm. in length and the distal three-fifths is distended and filled with a thick tenacious mucoid material, here the appendix measures 5 by 3 by 3 cm.; proximally the diameter varies between 3 to 4 mm., here the lumen is oblit-

erated and the wall of the appendix is of uniformly yellowish color. Microscopic examination shows a carcinoid tumor at the proximal portion of the appendix producing a mucocele.

capable of regression. They are found more frequently in females than males and occur between the ages of twenty-five to thirty-five years.

FIG. 2. Microscopic examination shows a carcinoid tumor at the proximal portion of the appendix producing a mucocele. The histologic picture is that of nests of spheroidal, naevus-like cells typical of the condition. The tumor extends to the peritoneal coat.

FIG. 3. Same as Figure 2 but under higher magnification.

The histologic picture is that of nests of the spheroidal, naevus-like cells typical of the condition. The tumor extends to the peritoneal coat.

Carcinoid tumors of the appendix are usually benign. Though single in the appendix, they are often multiple when they occur in the intestine. They vary in size from a millet seed to a cherry and in 80 per cent of the cases occur in the tip of the appendix, the submucous layer of the appendix being the usual site. They may, and often do, infiltrate the other layers and occasionally may break through the serous coat and behave like malignant tumors. Some authors consider them as real tumors and have applied the following names: basal cell cancer, basiloma, mucosal naevi, pancreatic and endocrine tumors. Other authors consider them inflammatory processes which are

Masson has advanced evidences that a definite relationship exists between carcinoid tumors and argentaffin cell neuromas. He believes that carcinoid tumors result from the autonomous proliferation of isolated argentaffin cells in the neuroma. The neuromas arise from the nerve plexus in the mucous membrane and these nerve fibers show the presence of argentaffin cells from which, he contends, the carcinoids develop.

Mucocele of the appendix is the result of obstruction at the proximal end of the appendix and the distal part dilates and forms a cyst. These cysts are invariably small, but may reach the size of a banana or the head of a fetus. The wall of the cyst is devoid of the muscular layer and contains thick tenacious mucus. These cysts when they rupture may produce a pseudomyxoma of the peritoneum. When this episode occurs the prognosis may be fatal.

CONCLUSION

The production of a mucocele of the appendix by carcinoid tumor has been rarely reported in the literature. The clinical picture in this case led to the diagnosis of acute appendicitis. Appendectomy was performed and the patient made a complete recovery. No roentgen therapy was instituted postoperatively. Both mucocele and carcinoid of the appendix are benign lesions. The combination is interesting and unique, but the favorable prognosis is in no wise altered by the association of the two lesions in the one appendix.

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APPENDICO-ILEAL FISTULA*

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A FISTULA between the appendix and any viscus is uncommon, and one between the appendix and terminal ileum is extremely rare. Garcia reported the only case of appendico-ileal fistula that we have been able to find in the available literature and believed it to be of congenital origin. It is our purpose to present in detail two cases of appendico-ileal fistula and to comment upon their development.

CASE REPORTS

Case 1. Mrs. H. L., white, aged sixty-three years, was admitted to the Jefferson Medical College Hospital on April 5, 1944 because of a "feeling of heaviness" in the right lower quadrant of the abdomen, associated with a "dragging sensation" in the epigastrium. These symptoms had occurred intermittently for ten years and were aggravated by eating green vegetables and fresh fruits. Relief could be obtained only by wearing an abdominal support. The patient could not recall any acute abdominal pain, nausea, vomiting, distention or abnormal stools. However, between the ages of thirty-eight and fifty-eight, she had been treated intermittently in another hospital for right ureteral stricture and pyelitis, associated with chills and fever but no pain, and without recurrence during the past five years. There had been no abdominal operation or injury.

Physical examination revealed the patient to be a slightly obese white woman in good general condition. Significant findings were limited to the abdomen where there was mild diffuse tenderness on deep palpation in the right lower quadrant, but no abnormal mass, distention or hyperactive peristalsis. Pelvic and rectal examinations were negative.

Laboratory studies revealed the following: Hemoglobin 13.8 Gm. per cc., erythrocytes 4,800,000 and leukocytes 8,000. The differential white cell count was normal, as were repeated urinalyses. The free and total acid curves of a gastric analysis were normal. The blood urea nitrogen was 15 mg. per cent (Van Slyke) and the urea clearance was 85 per cent of normal. Intravenous urography disclosed a double pelvis and ureter on the right side, extending to the level of the fourth lumbar vertebra, but there was no evidence of obstruction or calculi. The left side was normal. A cholecystogram was normal. A complete gastrointestinal roentgen ray study by Dr. Paul C. Swenson showed a short appendix as well as an abnormal patchy pattern of the distal portion of the ileum. (Fig. 1.)

The peritoneal cavity was opened through a lower right rectus incision. Pathological findings were limited to the lower right quadrant where the omentum was adherent to the cecum and terminal ileum. After freeing the omentum, a thin appendix was found extending from the cecum to an area of attachment on the anti-mesenteric border of the ileum, approximately eight inches from the ileocecal junction. (Fig. 2.) The appendix was one and one-half inches long and the serosal surface appeared normal. Distal to the attachment of the appendix the ileum was kinked and had undergone a moderate degree of torsion, whereas, proximally, it was slightly distended. The distal third of the appendix was firmly attached to the ileum and could not be separated by blunt dissection. After the mesoappendix had been tied and divided, the base of the appendix was ligated, severed with the cautery and buried into the cecal wall. The distal third of the appendix was then freed from the ileum by sharp dissection, at which time the appendico-ileal fistula was discovered. The opening in the ileum was repaired and the abdomen closed without drainage.

The postoperative course was uncomplicated and on the fourteenth day a gastrointestinal roentgen ray study showed a normal ileum.

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The patient was discharged from the hospital on the sixteenth postoperative day and has remained symptom-free for one year.

At examination the patient was an obese, middle aged, Italian woman, apprehensive and with obvious abdominal pain. Examination

FIG. 1. Roentgenogram showing the appendix and a patchy pattern of the terminal ileum. (On this film it appears that the anatomical relationship between the appendix and the ileocecal junction is abnormal, but this was disproved fluoroscopically as shown in insert.)

CASE II   Mrs. E. M., white, aged fifty-three years, was admitted to the Jefferson Medical College Hospital on December 29, 1943. Eleven days before admission she experienced diffuse abdominal pain, followed by nausea and vomiting. These symptoms persisted intermittently for four days and, on the fifth day, the pain decreased in intensity and became localized in the right lower quadrant. During the two days before admission the pain became more acute and was accompanied by diarrhea.

of the abdomen revealed moderate, bilateral, lower abdominal tenderness, most marked immediately above the symphysis, hypoactive peristalsis, and absence of distention, rigidity, abnormal mass and rebound tenderness. Rectal examination disclosed bilateral pelvic tenderness, most marked on the right where there was a fixed, fluctuant, extraluminal mass approximately three inches in diameter. The temperature was 100°F., pulse rate 100 and respiratory rate 20.

Laboratory studies revealed: Hemoglobin

12.3 Gm. per 100 cc., erythrocytes 4,300,000 and leukocytes 17,000. Urinalysis was normal except for a trace of albumen.

smelling pus was evacuated. The appendix could neither be visualized nor palpated safely, so was not removed. Drains were inserted into

FIG. 2. Illustration of findings at operation, showing the appendix joined to the terminal ileum. Insert shows the appendico-ileal fistula.
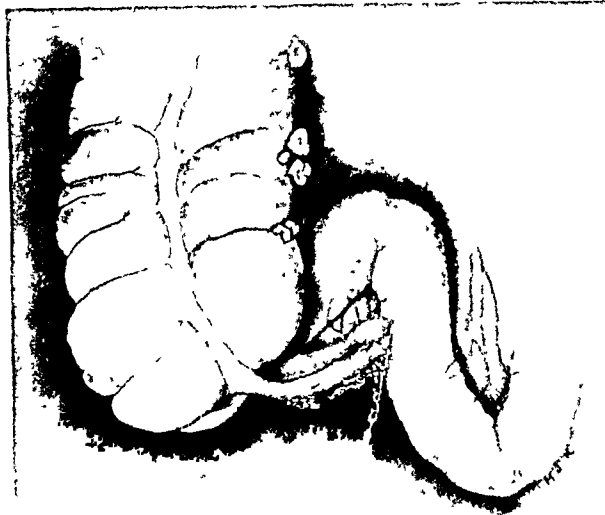
FIG. 3. Illustration of findings at operation, showing the appendix joined to terminal ileum. A circumscribed abscess is located in the angle formed by the appendix and ileum.

Upon opening the peritoneal cavity through a lower right rectus incision, an abscess, thought to be of appendiceal origin, was found filling the right side of the pelvis, from which 300 cc. of thick, greenish-yellow, foul

the abscess cavity, pelvis and right paracolic gutter, and the incision was closed in layers around the drains.

The postoperative course was satisfactory and the drains were removed during the

seventh to tenth days. The patient was discharged on the twenty-ninth day and was instructed to return later for appendectomy.

Readmission was on May 15, 1944, four and one-half months after the abscess had been drained. In the interim there was no recurrence of symptoms. The incision was completely healed and there were no physical findings indicative of an intra-abdominal inflammatory process. The hemoglobin was 10 Gm. per 100 cc., erythrocytes 3,800,000 and leukocytes 6,500.

At operation, upon entering the peritoneal cavity, multiple, local, dense adhesions of the omentum, small intestines and parietal peritoneum were encountered and released. The appendix was found lying on the mesentery of the ileum and its distal portion was adherent to the ileum at a point four inches from the ileocecal junction. (Fig. 3.) The appendix was two inches long, about average in diameter and did not appear inflamed but there was a small, well defined abscess, 1 cm. in diameter, located in the angle formed by the appendix and ileum. After the meso-appendix had been tied and divided, the base of the appendix was ligated, severed with the cautery and buried into the cecal wall. By sharp dissection the tip of the appendix was freed from the ileum and the appendico-ileal fistula was discovered. The appendix and adherent abscess were removed en masse and the opening in the ileum was repaired. The abdomen was closed without drainage.

The postoperative period was uncomplicated and the patient is entirely well one year after operation.

COMMENT

We believe that these two appendico-ileal fistulas were complications of previous appendiceal inflammation, whereas Garcia believed his case to be a congenital anomaly. In Case I, despite the congenital duplication of the right pelvis and ureter and the absence of a history of acute abdominal pain, the presence of adhesions in the ileocecal area intimates a previous inflammatory process as the underlying cause of the appendico-ileal fistula. In Case II the inflammatory origin of the fistula seems obvious, especially in view of the proximity of the persisting abscess.

Since appendicitis is a common condition and a resulting appendico-ileal fistula was observed twice by one group, the occurrence of such fistulas may be more common than the literature indicates.

CONCLUSIONS

1. Two cases of appendico-ileal fistula are described in which preceding appendiceal inflammation seemed to be the etiological factor.

2. The congenital hypothesis of appendico-ileal fistula seems untenable in our cases.

3. In view of the frequency of appendiceal inflammation and the proximity of the appendix to the terminal ileum, it is possible that the low incidence of appendico-ileal fistula is more apparent than actual because of observed cases not having been reported.

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TOOTHPICK IN A PERINEPHRIC ABSCESS

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PERFORATION of the intestine by a toothpick is uncommon. The discovery of a toothpick in a perinephric abscess is apparently unique. In Crossen and Crossen's summary (1940)[1] of 118 cases of swallowed foreign bodies in the abdomen, ten were toothpicks. In five the site of perforation was the cecum, and in one of these the perforation and abscess formation was retrocecal (Ginzburg and Beller's case). In the classification of abscesses of the perinephrium, the group of "simple" perinephric abscesses, in which no adjacent source of infection is found, may constitute about a third of the total.[2] Where no obvious focus of metastatic infection is found, it is customary to attribute the source to skin or upper respiratory infections. This is perhaps justifiable in view of the predominance of pyogenic cocci in simple perinephric abscess. However, it would seem from the following that the possibility of a foreign body from the intestine should be borne in mind particularly when typical "colon pus" is encountered.

CASE REPORT

A fifty-six year old white man was admitted to the hospital for a right inguinal herniorraphy. On admission he stated he had had a backache intermittently for five months, after a steer had broke loose and pinned him against a fence. The post-herniorrhaphy course was uneventful until the fifth day, when he developed a fever. This became septic in type, varying between 97 and 102°F. with occasional chills. The leukocyte count climbed slowly to 21,000. There were no gastrointestinal symptoms. There was moderate right upper lumbar pain and tenderness, which he continued to ascribe to the accident five months previously. Chest films and blood cultures were negative. The urine was negative except for rare pus cells. Intravenous pyelograms were negative as to renal complications but showed a soft tissue mass to the right of the midline, con-

FIG. 1. Intravenous pyelogram showing left lumbar scoliosis and soft tissue mass to the right of the midline, confluent with the psoas border.

fluent with the psoas muscle border. There was a left lumbar scoliosis.

A diagnosis of right perinephric abscess was made and exploration performed through a lumbar approach. A moderate sized abscess was encountered. Lying free in the cavity was an ordinary toothpick, slightly bent in the middle, but otherwise intact. The pus was of characteristic colon odor, and showed Gram-negative rods and short chained streptococci on smear.

Following operation the drainage diminished slowly, recovery being complete in two months. No fecal drainage was ever noted. The patient had no recollection of swallowing the toothpick.

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Comment. The effect of the previous accident and the hernia repair is largely speculative. I believe from the location of the abscess and type of bacteria that the toothpick gained access to the perinephrium through the posterior wall of the right colon. Perforation of the duodenum, with pointing of the foreign body and abscess down, or of ·the cecum, with migration superiorly, seem less likely.

SUMMARY

A toothpick was encountered in the cavity of a perinephric abscess, and was thought to have perforated the posterior wall of the ascending colon.

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A STONE in the kidney that cannot be easily removed by pyelotomy should be removed through an *incision into* the kidney, except in those cases of kidney stone with great destruction of kidney tissue, when nephrectomy is the operation of choice.

From "Operations of General Surgery" by Thomas G. Orr (W. B. Saunders Company).

ANNULAR PANCREAS CAUSING DUODENAL OBSTRUCTION

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ANNULAR pancreas causing duodenal obstruction is of rare occurrence and its importance from a surgico-clinical aspect is such that any case in which the patient is operated upon warrants reporting so that this condition may become known as a clinical entity and a suitable approach for its correction may be established. This is especially desirable since the data on operative intervention are limited to thirteen cases including this report. Because of the rarity of this anomaly and the unusual features of this case, we make this presentation:

CASE REPORT

Father R. C., a twenty-six-year old priest, was admitted to the hospital on January 26, 1945, with the following complaints: Pain of a dull and persistent nature in the pit of the stomach coming on one hour after a meal and relieved by more food or baking soda. The pain recurred on and off for the past year. It lately became unrelieved by food or soda, but bending or doubling over did relieve the pain. There was no characteristic radiation. Belching was present for two years. The patient, before seeking medical advice, treated himself for an entire year with baking soda and food ingestion with some relief. Vomiting occurred on two occasions. The first time, ten to eleven months preceding the hospital admission and the second time, two months before entrance. Both episodes of vomiting relieved the pain. There was loss of appetite for the past nine months, but unassociated with loss of weight.

When the patient finally sought medical advice a year ago, he was put on an ulcer diet and alkali therapy which relieved him of his discomfort until three months ago when the pain reappeared. Further medical management was unsatisfactory. Two weeks before his hospital admission he consented to a complete gastrointestinal x-ray investigation at which

time he was advised to be operated upon for an obstruction of his bowel. The past history and family history as well as the system review were non-contributory.

Physical examination on entry, revealed a well developed, well nourished, white, twenty-six-year old male, who was not acutely ill. Blood pressure was 120/70; temperature 98.6°F.; pulse 86. There was no evidence of weight loss or dehydration. The heart and lungs were normal. The upper part of his abdomen was prominent. There was no guarding or rigidity of the recti, but there was slight tenderness in the epigastrium to the right of the midline. No abnormal masses could be palpated.

Roentgenologic examination of the gastrointestinal tract revealed a moderate dilatation of the stomach and first part of the duodenum and a retention in both at the end of six and twenty-four hours. No other abnormalities were noted except the presence of a scoliosis. A diagnosis of marked obstruction in the second part of the duodenum was sufficiently established to justify surgical exploration for its relief.

Operation was performed under general anesthesia. A midline incision was made. On entering the abdomen, the stomach was found to be moderately dilated to about one and a half times the normal. The first and second portion of the duodenum were markedly dilated to about three times the normal diameter. The pyloric ring could be felt as a band between the dilated portions of the stomach and duodenum; the opening was moderately large. Adjacent to the right of the ascending colon, the incompletely rotated cecum was found with the appendix densely embedded in it. The distal third of the appendix was bound down to the underlying area of duodenal construction. Its tip was enlarged, and showed evidence of past inflammatory reactions. Adhesions were present between it and the gallbladder. It was removed and its base inverted. Further dissection uncovered

FIG. 1. Anteroposterior view of immediate stomach, showing definite constriction of the second portion of duodenum with dilatation of the first portion.

FIG. 2. Postero-anterior view of immediate stomach, showing dilatation of the first portion of the duodenum. There is scoliosis of the lumbar spine.

FIG. 3. Six-hour examination showing definite residue in stomach and duodenum.

FIG. 4. Twenty-four-hour examination showing residue in first portion of the duodenum.

the hard, annular band over the distal portion of the second part of the duodenum. It was about one inch wide and one-half inch thick,

fluids were taken freely on the second day. He had to be catheterized several times. Due to an upper respiratory infection, a temperature of
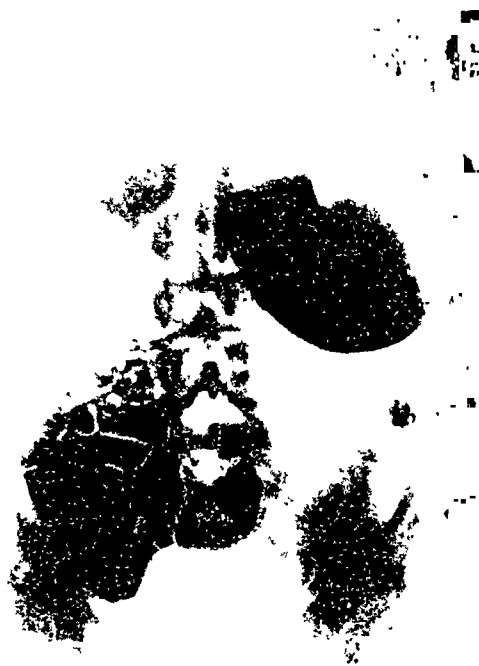
FIG. 5. Postoperative six-hour examination showing residue in stomach and duodenum.

FIG. 6. Postoperative twenty-four-hour examination showing gastric and duodenal residue.

and completely surrounded the duodenum, constricting its lumen to a very narrow diameter of about one-fourth inch. Its identity was established as pancreatic tissue. The duodenum was mobilized by cutting the mesentery to the right of it and the annular band was dissected free and cut transversely to the right of the head of the pancreas. It was further freed from the duodenal wall and a portion of about one inch was resected. This released the duodenal lumen so that it was possible to insert the index finger through its most constricted portion. Following this, the abdomen was closed in layers and not drained. The pathological examination of the tissue resected showed it to be pancreatic tissue with all of the histologic characteristics of a normal pancreas, including normal acini, ducts, and many islets. The appendix varied from 8 to 12 mm. in diameter, being larger at its tip. The tip was distended with fecaliths.

Postoperatively, the course was fairly uneventful. The patient was slightly nauseated, but free from vomiting the first day. Food and

102.6°F. was recorded on the evening of the second day. This gradually subsided, the patient being temperature free on the eigth day. At no time were there any signs of peritoneal irritation from possible pancreatic secretions, nor did any pancreatic fistula form as has been the experience in several reported cases (8, 10, 17). There was no wound infection. Eight weeks following surgery, although entirely symptom free and able to eat an unrestricted diet, the patient was routinely x-rayed. The films revealed a persistence of a twenty-four and forty-eight hour residue in the stomach and duodenum.

Embryology. Excellent detailed accounts of the embryological development of the annular pancreas have been presented by Howard,[8] McNaught,[11,12] and others.[1,3,4] The anomaly is thought to be the result of fixation of the ventral pancreatic bud which assumes an annular configuration when rotation of the duodenum occurs, Chapman and Mossman,[3] however, be-

lieve that the ventral pancreatic tissue spreads dorsally in a subperitoneal position around both sides of the duodenum rather than on one side as it normally does. As proof of this, they cite the presence of three pancreatic ducts and lobes as the normal condition found in birds. The former theory, however, is the one most accepted.

Clinical data, to date, reveal a total of fifty-two cases of annular pancreas reported in the literature. Thirteen of the cases, including our report, have been surgical problems; the others were incidentally found at postmortems or in anatomic laboratories. There were four deaths in the patients operated upon, a mortality of 31 per cent. The presence of an annular pancreas with a greater or lesser degree of duodenal obstruction is not incompatible with long life as is shown by the upper age group in which this anomaly was found. The oldest patients operated upon being seventy-four years old (Smetana[13] Custer and Waugh[5]). Excepting two cases found in three-day old infants, (Vidal[16] Cross and Chisholm[7]), the ages varied from twenty-three to seventy-four years. The majority of the cases were asymptomatic throughout life and attention was called to the anomaly by the presence of pathologic processes in the same or continguous organs. In some,[1,5] an acute pancreatitis or a duodenal ulcer or as in our case, a pathologic appendix precipitated the investigation leading to the discovery of the annular pancreas.

COMMENTS

A number of surgical procedures have been suggested for the correction of the obstruction caused by the anomaly. Of the thirteen patients operated upon and reported by others[1,2,5,6,7,8,9,10,13,15,16,17] including ours, a partial resection or division of the ring was performed in five. All had a complete recovery with the exception of Lehman's case[9] which had persistent postoperative symptoms. Posterior

gastroenterostomy was performed in five cases of which three died of intercurrent infections or associated pathologic processes. Duodenojejunostomy was performed on a three-day old female by Gross and Chisholm[7] with complete cure. In the case reported by Custer and Waugh[5] a gastric resection including the upper 8 cm. of duodenum was performed for an associated gastric ulcer. An anterior long loop gastroenterostomy was done. The reported result was good.

TABLE I*

CASES OF ANNULAR PANCREAS TREATED BY OPERATION

Case	Reported by	Age— Sex	Operation	Result
1	Vidal 1905	Male 3 days	Posterior gastroenterostomy	Cure
2	dos Santos 1906	Female 26 yr.	Posterior gastroenterostomy	Died (pneumonia)
3	Lerat 1908	Female 46 yr.	Resection of pancreatic ring	Cure
4	Smetana 1928	Male 74 yr.	Posterior gastroenterostomy	Died
5	Howard 1930	Female 46 yr.	Division of ring	Cure
6	Brines 1930	Male 35 yr.	Drainage of pancreatitis	Died
7	Zech 1931	Female 27 yr.	Division of ring. Heineke-Mikulicz plastic on duodenum	Cure
8	Brines 1931	Male 44 yr.	Posterior gastroenterostomy	Died (respiratory infection)
9	Truelsen 1940	Male 35 yr.	Posterior gastroenterostomy plastic on duodenum	Cure
10	Lehman 1942	Male 23 yr.	Partial resection of ring	Recovery, but persistent symptoms
11	Gross and Chisholm 1944	Female 3 days	Duodenjejunostomy	Cure
12	Custer and Waugh 1944	Male 72 yr.	Gastric resection	Cure
13	Goldyne and Carlson	Male 26 yr.	Resection of ring	Cure

* After Gross and Chisholm.

Considering the lack of mortality, resection of the pancreatic ring appears to be the safest method, thus far, despite the hazard associated with cutting through pancreatic ducts, and the consequent development of pancreatic cysts and fistulas. However, it is readily conceded that because of the meager literature and experience with this anomaly, the safest procedure is yet to be determined. The

fact, called attention to by other investigators,[3,4,7,11,14] concerning the association of other anomalies with this condition is further substantiated by this case. The diagnosis of annular pancreas has not been made preoperatively in our case or in any of those reported. The lesion being difficult to differentiate from other causes of duodenal obstruction. We have personally encountered three cases which could not be differentiated roentgenologically from the obstruction caused by an annular pancreas. These were, two cases of congenital duodenal atresia in the newborn, and one case of a constricting carcinoma of the second portion of the duodenum.

SUMMARY AND CONCLUSION

A case is presented in which the patient had duodenal obstruction due to an annular pancreas. It was treated by division of the ring and resection of a part of it. A short summary of its embryology is given. It is deduced that annular pancreas is compatible with life and may not give rise to any symptoms. Its presence is often called attention to by an associated inflammatory reaction in the pancreas itself, or a contiguous organ. Resection of the ring may not relieve the obstruction entirely, yet the patient may be symptom free. Attention is again called to the associated anomalies with this condition; in this case an incompletely rotated cecum and a pathologic superimposed appendix. This is the first case reported which has not developed a pancreatic cyst or fistula following resection of the annular tissue, and the first that is symptom free despite evidence of gastric and duodenal retention. We believe that resection of the annular band, in spite of the objectionable development of pancreatic cysts and fistulas, merits consideration as the operation of choice because of the lack of mortality associated with this procedure.

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NEW INSTRUMENTS IN RHINOPLASTIC SURGERY

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IT is a truism in rhinoplastic surgery that the correction of the nasal base, in the course of the operation for shortening the nose is, in effect, a stumbling

FIG. 1. A, self-retaining alar retractor; B, reversible alar separator; C, mucocartilaginous separator.

block to the unskilled. Difficulty is encountered in shaping the lower lateral cartilages to conform with the newly shortened nose. This is particularly true where the usual trimming of these cartilages is concerned which, in the main, form the nasal rim. If improperly shaped, the resultant esthetic result is poor and there is also a grave possibility of disfigurement of the rim (often resembling a notch) of the nose which is almost beyond repair. This is not an uncommon consequence of inept rhinoplasty.

It is, therefore, advisable to expose the lower lateral cartilage from the superior border. With this in view I have designed the following three instruments which are of great advantage in simplification of the technical difficulties encountered in this step of the operation.
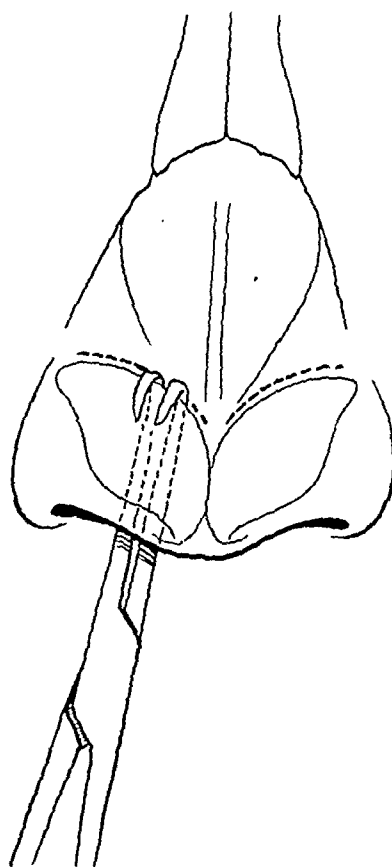
FIG. 2. Manipulation of separator.

1. *A Self-retaining Alar Retractor.* This instrument permits adequate visibility and eversion of the cartilage so that it can be separated from the medial mucous membrane as well as from the skin. The shank of the instrument is about three and one-half inches long. At each extremity are two prongs parallel to each other. Along

the shank there is also a moveable gadget, single toothed on each side, which may be brought down to either end of the

3. *The Mucocartilaginous Separator.* This instrument resembles (2) with the exception that the cutting edge, instead of
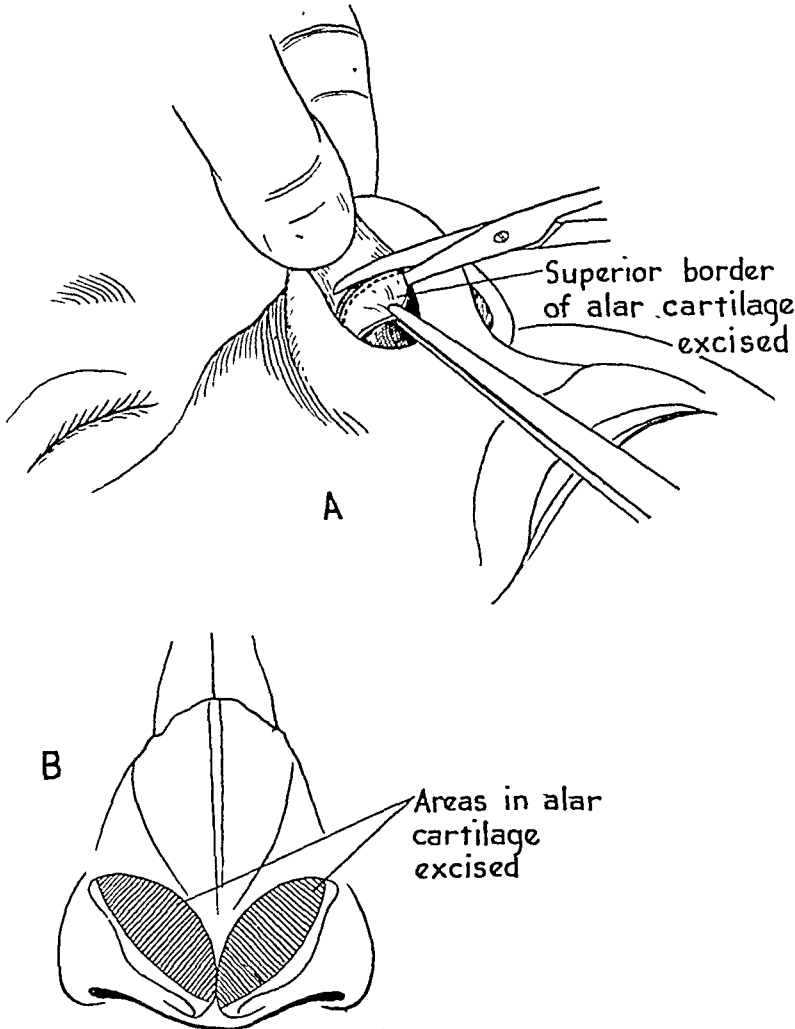
FIG. 3. A, eversion and trimming of lateral cartilage; B, area excised.

instrument and tightened *in situ* by means of a screw. When the gadget is lowered, or elevated, it overlaps the other prongs on the opposite side, thus embracing the alae. The screw when tightened immobilizes the part.

2. *A Reversible Alar Separator.* As the name denotes, this instrument separates the lower lateral cartilage from the skin when it is inserted posteriorly to the cartilage and brought downward toward the base, cutting two ways in reverse. Its dual cutting edge is ideally adaptable to the technical step for which it is designed.

having a large curve, has a slight angulation at its tip, which facilitates the separation of the mucous membrane from the cartilage. This instrument also has two cutting edges. After separating the cartilages (lower lateral) from the skin and mucous membrane, they are resected and trimmed to the desired effect, leaving the mucous membrane intact. The lateral aspect of the nose is thereby decreased without deformation of its rim.

The aforesaid technic, therefore, is advantageous in that it leaves the mucous membrane intact, contributes to the lateral nasal shortening and eliminates the possibility of disfigurement of the rim.

A SELF-RETAINING HEMI-LAMINECTOMY RETRACTOR*

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IN spinal cord surgery total laminectomy has been almost entirely replaced by the less traumatizing and deforming procedure of hemi-laminectomy. In our experience, this latter procedure has been found adequate for exposure in exploration of a cord segment, lysis of adhesions, tractotomy, and removal of herniated discs and small cord tumors. Total laminectomy is performed only where a decompression of the spinal cord is indicated, such as in compression fracture of the spine, Paget's disease or where removal of a neoplasm is impossible or contraindicated and decompression only is desired, and occasionally in cases in which a cord tumor is very large. Retractors designed for total laminectomy cannot be effectively used in exposing laminae on only one side of the posterior spine because their blades usually are of similar design. Necessarily the blade placed against the posterior spines, if designed to retract muscle, obstructs exposure of the laminae and base of the spines. Having no entirely satisfactory hemi-laminectomy retractor available a retractor was designed.

Perusal of the catalogues of the leading manufacturers of surgical instruments[1] in this country revealed no retractors effectively designed especially for hemi-laminectomy. The Frazier total laminectomy retractor is most commonly displayed and used. This retractor, however, is totally inadequate for exposure of one side of the posterior spines and laminae since the tines obscure the field if placed against the bony spines, and if applied more superficially they fail to retract the paraspinous muscle completely. A modification of the original Frazier retractor[4] has been proposed only as an emergency measure. There are many other manual and self-retaining retractors such as the Israel, Oldberg, Kananel-Davis, Beckman-Adson[1] and Meyerding retractor,[2] to name only a few. The manual retractors, although built for ease of grip, tax the strength of the second assistant and the patience of the operator, since the assistant's arm necessarily crosses the operative field. The available self-retaining retractors[3] all employ similar blades, thus making traction on two different types of tissue—bone and muscle—unsatisfactory.

The retractor about to be described (Fig. 1) uses the sliding tension-lock principle. The blades, however, are of original design after the experimental use of several varying designs on a cadaver at different levels of the spinal cord. Adjustable blades were originally designed, but were found to be impracticable because of inherent mechanical weaknesses. It was believed that the simplest instrument performing adequately the task of retraction was the desired one. An instrument with blades 2½ inches in depth was then chosen, since this depth was found adequate in all regions of the spinal column in cadavers of varying habitus. The blade retracting the paraspinous muscle (A) is deep enough to retract the entire muscle group and the space between the tines is such as to confine the muscle entirely, thus clearing the field of operation. The blade to be placed against the posterior spines (B) obtains traction from small burrs on the contact surface and the arm of the blade is cleared from the operative field by the angulation at the base of the blade. Blade (A) also fits into the opening

in the opposite blade (B), facilitating the placement of the retractor after the paraspinous muscles have been freed from

The instrument has been found to afford excellent exposure at the base of the posterior spines, which often have to be under-
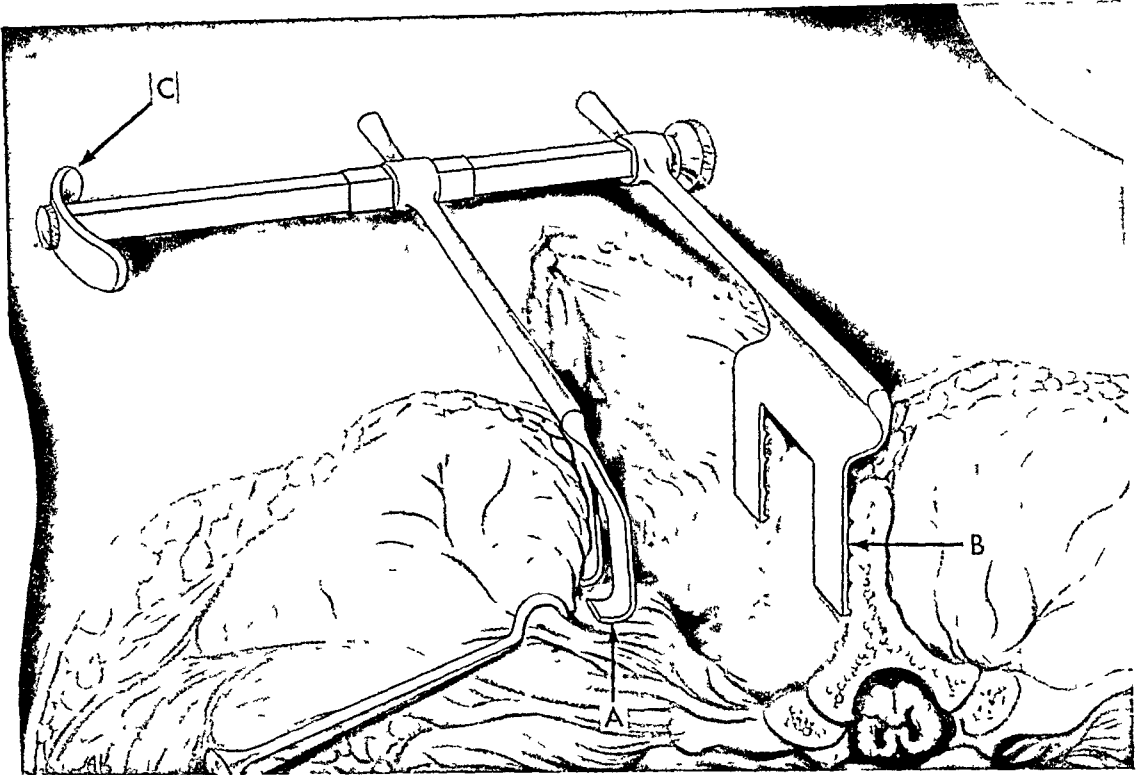
FIG. 1. Self-retaining hemi-laminectomy retractor in position (lumbar region). A, blade for muscle retraction; B, blade for bone countertraction; C, handle for facilitating the placing of the retractors.

the posterior spines and laminae for the distance desired. The handle (c) is added for countertraction to facilitate opening the retractors against the pull of the paraspinous muscles.

This new self-retaining hemi-laminectomy retractor is presented as giving more adequate exposure than is now available using the existing retractors. The instrument has been used by us in over thirty hemi-laminectomy procedures, for varying indications, at all levels of the spinal cord with excellent exposure in each case. It has also been used by several other operators with equally satisfactory results.

mined to allow adequate exposure of the cord.

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RAT TRAP RETRACTORS

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IN surgical procedures it is helpful to have simple retractors which are not in the surgical field. Although the idea of spring retractors is not new, the procurement of such is extremely difficult in present times. The need for spring retractors caused a search which ended with the purchase and manufacture of satisfactory retractors at a nominal fee.
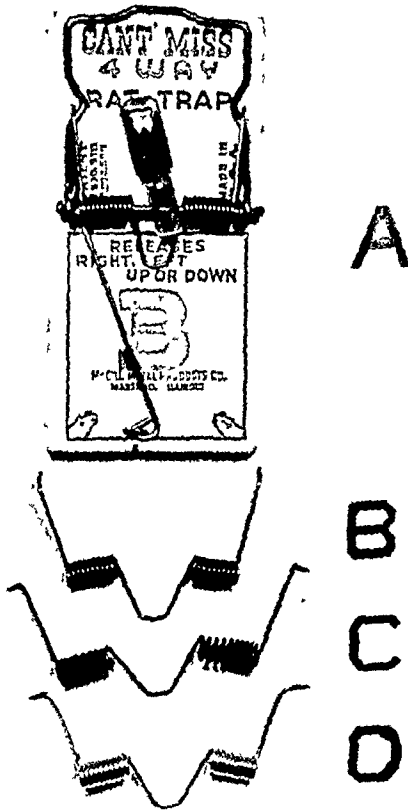
FIG. 1. A, rat trap; B, main spring removed; C, main spring widened and with ends sharpened and turned laterally; D, same as C, silver plated.

FIG. 2. Retractors retracting platysma and skin and exposing thyroid gland.

Rat traps (A) were purchased and the main spring removed (B). The ends were turned directly lateralward and sharpened (C) to maintain a grasp on the tissues in which they were placed. The middle portion of V of the spring may also be widened by bending to give a wider spread to the retractor (C). Thus at twenty cents a pair and a few minutes' work serviceable retractors are available. They, however, are not rust proof and if the surgeon chooses he may have these silver plated (D) for thirty-five cents apiece making a total cost of forty-five cents each. These are very useful in hernia and thyroid surgery, the latter of which is exemplified by Figure 2. The springs are shown outside the drapes to visualize them. In actual use they are placed beneath the drapes on either side, being entirely out of the operative field.

Editorial

THE AMERICAN MEDICAL ASSOCIATION SHOWS THE WAY

TO paraphrase Winchell, "Orchids to the American Medical Association for their sane and straightforward blueprint of prepayment sickness insurance plans and health program." Many physicians, from general practitioner to full time professor, believe we have turned a corner and are witnessing the birth of a new era in the economic life of our profession. After long study and consideration a series of meetings were held in Chicago (beginning February 13 and the Board of Trustees and the Council on Medical Service "completed consideration which made possible a long step toward protecting the American people against costs of sickness."

Dr. Morris Fishbein, in an editorial (February 23, 1946) in The Journal of the American Association wrote:

"The fundamental step in the development of this plan was the establishment of standards of acceptance for medical care plans which have the approval of the Council on Medical Service of the American Medical Association. Any plan which meets the standards of the Council will be entitled to display the seal of acceptance of the American Medical Association on its policies and on all of its announcements and promotional material. In order to qualify for acceptance, the prepayment plan must have the approval of the state or county medical society in the area in which it operates. The medical profession in the area must assume responsibility for the medical services included in the benefits. Plans must provide free choice of a qualified doctor of medicine and maintain the personal, confidential relationship between patient and physician. The plans must be organized and operated to provide the greatest possible benefits in medical care to the subscriber.

"Medical care plans may be in terms of either cash indemnity or service units, with the understanding that benefits paid in cash are to be used to assist in paying the costs incurred for medical service. The standards also include provisions relative to the actuarial data that are required, systems of accounting, supervision by appropriate state authorities and periodic checking and reporting of the progress of the plan to the Council.

"Coincidentally with the announcement of these standards of acceptance there was organized, as a voluntary federation, an organization known as Associated Medical Care Plans, Inc. This independent association will include as members all plans that meet the minimum standard of the Council on Medical Service of the American Medical Association. The Associated Medical Care Plans will undertake to establish

coordination and reciprocity among all of these plans to permit transference of subscribers from one plan to another and use of the benefits in any state in which a subscriber happens to be located. Under this method great industrial organizations with plants in various portions of the United States will be able to secure coverage for all their employees. Moreover, it will be possible for the Veterans Administration, welfare and industrial groups and government agencies to provide coverage for the people in any given area through a system of national enrolment. In addition the Associated Medical Care Plans, Inc., will undertake research and the compliation of statistics on medical care, provide consultation and information services based on the records of existing plans and engage in a great campaign of public education as to the medical service plan movement under the auspices of state and county medical societies.

"The Board of Trustees of the American Medical Association also announced establishment of a Division of Prepayment Medical Care Plans with a director and a staff who will administer the activities related to the promotion and development of medical care plans in all the states.

"In announcing these proposals for a nationwide provision of sickness insurance on a mutual nonprofit basis, the Board also presented a complete health program with ten points, which include the development of services in the field of preventive medicine, maternal and child health, voluntary prepayment plans for protection against the costs of sickness, compensation for loss of wages due to illness, the care of the veteran and the development of a high standard of housing, nutrition, clothing and recreation."

Many informed physicians believe the prepayment sickness insurance plans will succeed. Surely it is the American Way. Once it becomes established and is a part of our professional life the nightmare of some form of socialized medicine with a crew of rapacious politicians at the helm will fade and die.

We hope those who read these lines or who have read the original editorial in The Journal of the A. M. A. will give the proposals thought and study, and then go forth and "preach the gospel" so that these sane, practical and forward-looking plans will become a reality.

Again, to those gentlemen of The American Medical Association who have labored for the good of the profession as a whole, we make a deep and sincere bow.

T. S. W.

Original Articles

URINARY CALCULI IN RECUMBENT FRACTURE PATIENTS

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THE presence of urinary calculi in fracture cases attracted the attention of the authors during the past year because of the extreme discomfort to the patient already disabled, and because of residual damage to the kidney which sometimes necessitates its removal.

On an active orthopedic service of about 700 beds, it was our privilege to observe twelve cases of fracture with this complication. All cases were examined and treated by the Department of Genito-urinary Surgery, while the fracture treatment was continued. These cases are herewith reported in the hope that some light may be thrown upon the prevention and treatment of this rather common complication of fracture patients who are kept recumbent over a long period of time.

LITERATURE

Lediard (1875) recorded a case of stone in the bladder developing after treatment for a spinal fracture in which the urine was heavily infected. Wilson (1931) reported instances of renal colic and hematuria in twenty-three out of 150 men who suffered from fractured femurs during World War I. His patients were recumbent for periods of from three to twelve months, and most had severe wounds, often infected, which were sometimes associated with ununited fractures. Hematuria was present in nearly every case and all had renal colic, which was sometimes bilateral. The symptoms usually occurred on the first day the patient was allowed out of bed. One patient passed three or four friable calculi. In all but two the urine was sterile. A few patients only were x-rayed, and in these, no calculi were demonstrated. Paul, and also Borman, recorded some cases of "recumbency calculi" developing in patients suffering from bone suppuration. Wallenstein (1931) recorded a case of bilateral renal calculi, one of which was demonstrated radiographically five weeks after immobilization for a fractured spine with paraplegia for which laminectomy was performed; the urine was probably infected, as regular catheterization was carried out for a period. Mawson (1932) recorded twenty-five cases of urolithiasis in children between the ages of eighteen months and fourteen years who were immobilized for tuberculosis of the spine or hip, slipped epiphysis, septic arthritis of the hip and knee, and spina bifida. Brown and Earlam reported six cases of "recumbency calculi." They divide calculi of this class into those which arise in association with a non-infected lesion, such as a fractured pelvis and those arising in patients suffering from bone suppuration. Holmes and Caplan (1934) recorded cases of extensive bilateral calculus formation rapidly developing after a fractured spine with paraplegia. McCague (1905) recorded ten cases of calculi following fractured pelvis, osteomyelitis of the femur, shell injury, and fractured spine, in four of which cases the calculi were bilateral. Key (1936) investigated complications in the urinary tract in 200 children recumbent for various orthopedic diseases and found such complications in thirty-two cases, mostly children

under treatment for tuberculous hips or spines. In twenty out of thirty-two instances, calculus (renal, ureteric, or vesical) was present, pyelitis in nine, and renal tuberculosis in three. Sick records five cases of recumbency calculi following fractured pelvis or spine.

ETIOLOGY

I. *Anatomy of Urinary Tract Favors Stasis and Infection When the Patient Is in the Dorsal Decubitus Position.* The hilum of the kidney faces forward and inward; in the dorsal decubitus the renal watershed will, therefore, lie at the pelvi-ureteral junction resulting in a tendency for a reservoir to form in the calici pelvic system. There is consequently more time for salts in a concentrated urine to pass out of solution—salts that would otherwise not have been deposited until the urine was voided. In addition, there is a gravitational influence upon any cells or débris, which may cause them to remain as potential stone nuclei.

In its early stages, the renal calculus of the ambulatory patient is usually located in the lower calices or pelvis, and is very rarely found in the upper calices; this is probably due to the fact that, in the erect position, the lower calices lie below the outlet of the renal pelvis, and are, therefore, less perfectly drained than the remainder of the system. In the recumbent patient, however, the calices are all placed under approximately the same conditions of drainage, and the calculus is frequently found in the upper, as well as in the middle and lower calices.

II. *Stone Areas.* According to Lassen, there is some predilection of the condition for so-called stone areas. In Africa, urinary calculi are frequent among the population of the Northern and Eastern coasts. Also, in Dutch East Indies, South China, the Valley of the Volga River, Mesopotamia, Persia, Afghanistan, Turkestan, Northwestern India and Japan. Our patients were all young men whose homes were scattered throughout the United States and had seen service in both the Atlantic and Pacific areas.

III. *Dietary Effects.* In many children's orthopedic hospitals, there is a tendency to emphasize the ingestion of large quantities of milk. The excess calcium intake in conjunction with the hypercalcemia normally associated with fractures and other cases of bone disorders causes further excretion of calcium in the urine. The latter combined with the poor drainage from the kidney because of the patient's recumbency may cause a precipitation of calcium. Dehydration resulting from insolation and low intake of fluid are also contributory to calculi formation. In most instances in which calcium stones have been formed, the precipitation took place in an alkaline medium.

IV. *Heredity.* This seems of actual significance among persons who have cystinuria or cystin-calculi, which conditions are decidedly familial in nature. In our series there was no family history of urinary calculi.

V. *Infection.* Infection seems to have the effect of changing the reaction of the urine and particularly the effect of increasing the hydrogen ion concentration. As a consequence, the condition of saturation in the urine often will undergo considerable change, so that the possibility of precipitation, especially of phosphates and carbonates becomes greater. This is seen in particular in cases of infection by urea-splitting organisms, members of the genus Proteus and others. It is possible that in the case of infection, there is also an increase in colloids, or that colloid metabolism is changed. Theoretically, as the colloids split, more surface may be present, and adsorption may take place. However, colloidal suspensions are rarely stable because on standing, the particles tend to coalesce and reduce the surface area. Furthermore, bacteria and inflammatory products themselves may form nuclei for stone, which may become incrusted and continue to grow. Rovsing, Hellstrom and other authors, have suggested such a pos-

sibility. Priestley, also, reports certain bacteria such as proteus ammoniae, staphylococci, and certain streptococci which

to such deficiency being a contributory factor in the formation of renal calculi in general. Mawson points out that many
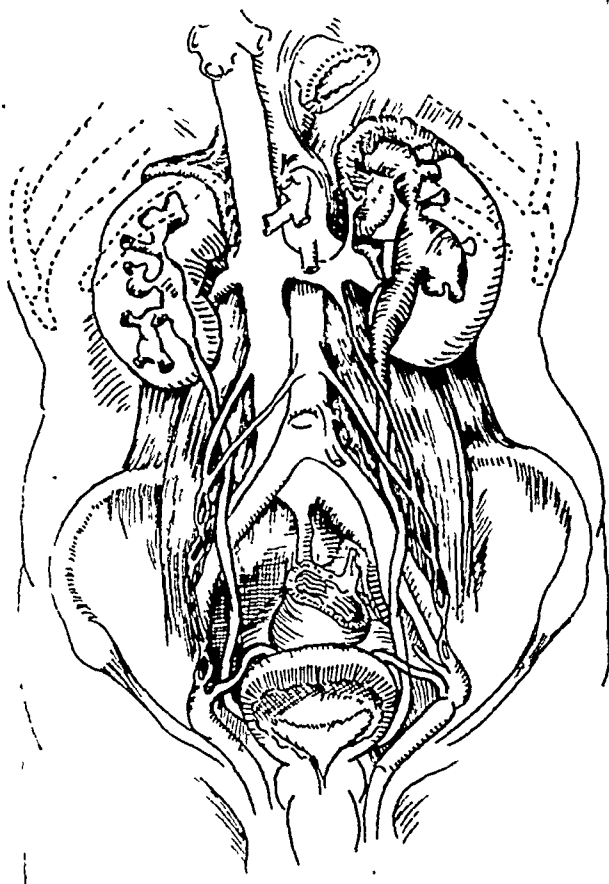
FIG. 1. Anatomy of the urinary tract.

split urea into ammonia and carbon dioxide, thereby creating an alkaline urine. These are the organisms most commonly associated with the presence of stones. Bacillus proteus is due to contamination. If an individual has calculi entirely removed, he may have further calculi precipitated if Proteus infection continues.

VI. *Hyperparathyroidism.* Interest in the dysfunction of the parathyroid glands has been stimulated lately. However, most authors agree that cases of urinary calculi due to disease of the parathyroid glands are rather rare. Barney and Mintz state that hyperparathyroidism is responsible for about 1 per cent or less.

VII. *Deficiency of Vitamin A.* The evidence so far available points strongly

parts of the world where renal calculus is very common, the diet consists largely of carbohydrate foods and is deficient in proteins and in vitamin A. The diet containing vitamin A is usually adequate in most hospitals, but the power of absorption of vitamin A by the bowel may be defective in some cases.

VIII. *The Possibility of Hypervitaminosis D Resulting in Renal Calcification.* Experimental work with rabbits, dogs and guinea pigs seems to demonstrate some relationship. Thatcher (1936) has recently recorded a further case of a baby eleven and one-half months old, who died after a period of failing health of four months. The only cause of death found at the autopsy was calcification in the kidneys

resembling exactly the changes found in fatal cases of hypervitaminosis D reported in animals. We are on more difficult ground ureter, strictures and the like, or acquired lesions, such as infection of the urinary system by various bacteria, ren mobilia,
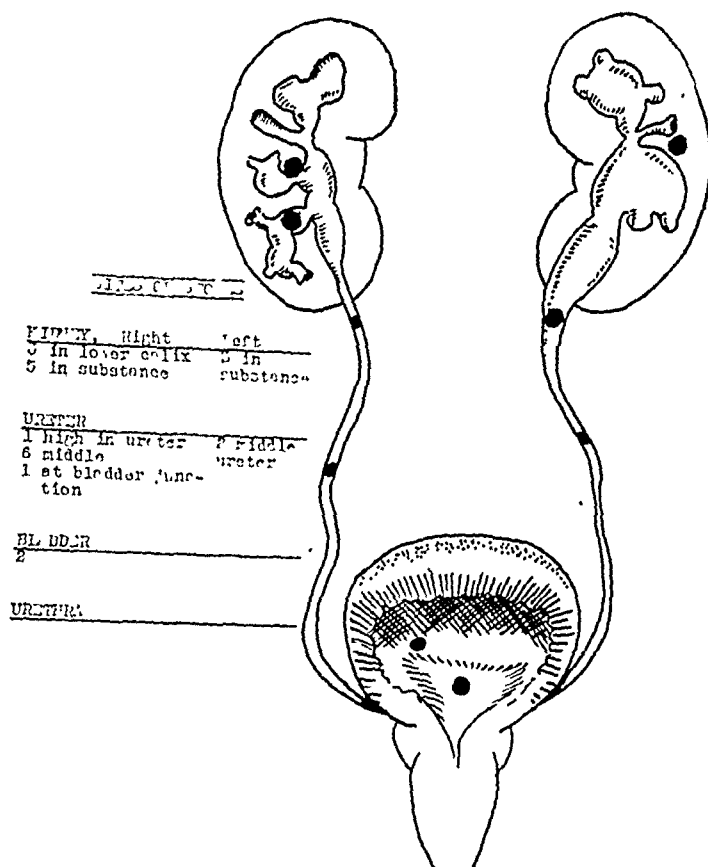
FIG. 2. Sites of urinary calculi.

when we come to the question of the over-production of the vitamin D by insolation. Vitamin D is synthesized in the skin by the action of ultra violet light. Pigmentation constitutes the natural defense mechanism of the body against this over-production by the action of the sun's rays. Any marked excess of vitamin D in the body will result in the elevation of the serum calcium. Hoyle suggested that prolonged exposure to the sun may be a cause of stones in the kidney. However, most authors at present, feel that the elevated calcium in the blood is due to the hypercalcemia normally associated with fractures.

IX. *Congenital conditions* such as horseshoe kidney, aberrant vessels, valvular formations in the pelvis of the kidney or

stricture and others, may be contributory. There was one case in our group of stricture of urethra as an added complication of simple fracture of the first and second lumbar vertebrae.

Flocks' most recent article on calcium urolithiasis mentions the following conditions which predispose to urinary stone.

I. Disease producing prolonged immobilization of the body, such as,

(a) Fractures of the spine or extremities associated with prolonged immobilization of long bones.

(b) Chronic osteomyelitis

(c) Chronic arthritis, or other bone joint disease producing immo-

bilization of large portions of the skeleton.

    (d) Neurological damage as result of trauma-producing immobilization.

II. Changes in Urinary Organs:
    (a) Congenital anomalies associated with stasis
    (b) Acquired obstruction such as stricture of urethra
    (c) Paralysis of urinary passageway
    (d) Introduction of infection into urinary tract
    (e) Foreign body in urinary passageway

III. Endocrinopathies:
    (a) Hyperparathyroidism

IV. Forms of infection elsewhere in body?

V. Vitamin deficiency or excess:
    (a) Vitamin A deficiency
    (b) Vitamin D excess

VI. Metabolic Abnormalities:
    (a) Idiopathic hypercalcaemia
    (b) Changes in colloids

INCIDENCE

The urinary calculi to be discussed occurred in white males between the ages of twenty and thirty, average twenty-five plus. In our group of twelve cases it was of interest to note there were no negroes. In 150 war cases with fractures of the femur, Wilson, in England, reported 15 per cent with renal colic and hematuria. Cases have been reported as early as eighteen months of age. The condition occurs more frequently in the male than in the female. This ratio is almost four males to every three females as reported by English study. The prostate gland is said to be responsible for the difference between the ratio of the male and female. It is easily understood that with hypertrophy, infection or new growth, the prostate may so constrict the urethra that the bladder, ureters, and kidneys will not be able to drain properly. This static condition of urine is again conducive to precipitation, especially if there is an associated urinary infection.

SYMPTOMATOLOGY

The symptoms are the same as those seen with calculi in non-recumbent patient, that is, colic, blood in the urine, and often the passage of the calculus in a few days. According to Carlson and Ockerblad, it occurs more frequently when the patient's position is changed after being recumbent for a long period of time. The diagnosis is substantiated by x-ray examination. Since most of the stones are calcium stones, even the earliest calculi may be seen on a good x-ray plate. According to Pyran and Fow Weather, hematuria is the foremost symptom in urinary calculi associated with recumbency. However, in urinary stones associated with enforced recumbency, experience shows colic is more common than is hematuria. In some few cases, calculi manifest their presence by the sudden appearance of chills, and fevers of unknown origin. This, of course, is indicative of associated infection and microscopic examination of the urine will make the diagnosis. It must be remembered, however, that a true pyonephrosis may be present in conjunction with renal stones and the urine will give no hint of renal infection.

In Order of Appearance	No. of Cases
Colic and pain	10
Hematuria	6
Burning on urination	3
Costo-Vertebral tenderness	3
Frequency	1
Chill	1

Note: Some of the patients manifested more than one symptom.

SIGNS

The renal calculus, without infection, does not afford diagnosis by any physical diagnostic sign. However, when obstruction occurs, the usual sign of renal pelvic distention is present—tenderness to deep pressure at the costal vertebral angle of the affected side. The abdomen even during acute attacks of renal colic, may or may not reveal evidence of muscular spasticity. When there is no spasticity the patient will often complain of a generalized abdominal

Operations	Type of Individual	Other Complications	Site of Stone	Area from Which Admitted	Sulpha Therapy	Warning Signaling Investigation	Type of Immobilization	Number of Days of Immobilization	WBC in Urine	Crystals	Injury	Urine Reaction
Bone graft and cystoscopic	Tall and Thin	1. Infection of pin site 2. Another calculus present	Right uretero-vesical junction	North Atlantic Area	Yes	1. Rt. lumbar spasm 2. Burning on urination 3. Hematuria 25 days, 35 days (ambulant)	Plaster spica with pin incorporated	290	3-4 Leucocytes. Countless Lymphocytes	Few dicalcium Phosphate	Fracture Right Femur	Alkaline
Lane plate tibia closed Red. Femur	Tall and Thin	Fracture Tibia and Fibula	Lower calix Right kidney Lower left ureter	South Atlantic Area	Yes	1. Pain left kidney region	Roger-Anderson splint	300	2-3 h.p.f.	Rare Calcium Oxalate. Rare Sulpha Crystal	Fracture Multiple Pelvis. Dislocated Lip Fracture left Femur and Acetabulum	Alkaline
Triple arthrodoesis Lane Plate Femur	Short and Stocky	None	Lower right Calices	North Atlantic Area	Yes	1. Pain burning lower left quadrant 2. Tenderness over Right Kidney	Double Hip Spica	270	Countless	Much amorphous material. Many sodium urate crystals	Fracture comp. Left Astragulus. Fracture comp. Left Femur	Acid
Sequestrectomy	Tall and Thin	Osteomyelitis	Pelvis of left Kidney	Pacific Area	Yes	1. Pain and chill llq following urination	Double Hip Spica	76	6-8 W.B.C.	Calcium oxalate and carbonate	Comp. Frac. Rt. Femur Draining wound over R. Patella	Alkaline
Ostectomy Bone Graft Femur	Stocky	1. Abscess at pin site 2. Large stone still present	Small stone in each kidney & large one in left ureter	Pacific area	Yes	1. Pain in lower left quadrant	Roger-Anderson splint Haynes splint	517	45 w.b.c.	Calcium phos. oxalate	Comp. Frac. Rt. Femur Rt. Peroneal Nerve Injury	Weakly acid
Plastic on urethra Cystoscopic	Tall and Thin	Recurrence of calculi residual stricture Pelvic-Osteo	1 in rt. pelvis and 3 in right lower ureter	Pacific Area	Yes	1. Pain in right lumbar region 2. Hematuria 3. Burning on urination	Double Hip Spica	180—1st stone 270—2nd stone	Countless	Triple and amm. phosphate	Un-united frac. Left pubis and Ischium. Rupture Urethra	Alkaline
Sequestrectomy	Tall and Thin	Osteomyelitis	Stone in rt. lower ureter	Pacific Area	Yes	1. Pain in rt. loin radiating to groin 2. Costo-vertebral tenderness 3. Frequency	Double Hip Spica	223	Countless	Magnesium and calcium carbonate. Few calcium oxalate	Fracture comp. Rt. Tibia and Fibula and Femur	Alkaline

Urine Reaction	Injury	Crystals	WBC in Urine	Number of Days of Immobilization	Type of Immobilization	Warning Signaling Investigation	Sulpha Therapy	Area from Which Admitted	Site of Stone	Other Complications	Type of Individual	Operations
Alkaline	Comp. Frac. Rt. Femur Lesion of rt. Sciatic	Rare calcium oxalate	4–6 w.b.c.	128 316	Double Hip Spica	1. Pain in right lumbar area 2. Tenderness over rt. kidney 3. Hematuria	No	North Atlantic Area	Inferior rt. kidney pelvis Rt. ureteralstone (calix) Several right renal stones	Draining sinus at wound site	Stocky	Ostectomy and Bone Plated
Alkaline	Fracture simple and dislocation of 12th D vertebrae	Triple phosphates	Countless	622	None	1. Pain right costo-vertebral junction 2. Hematuria	Yes	Atlantic Coast	Right ureter bladder	Paraplegia and cord bladder	Tall and Thin	Cystotomy and Laminectomy
Weakly acid	Frac. Comp. Rt. Tibia	Triple Phosphates	4–6-w.b.c.	89	Cast right mid-thigh to toes	1. Pain left costo-vertebral area 2. Hematuria	Yes	Pacific Area	Pelvic portion of left ureter	Draining sinus right leg	Tall and Thin	Debridement
Weakly acid	Simple Frac. of L-1 & L-2 Lacerated left hand	Much Amorphous material	Countless	471	Plaster Jacket	1. Pain over bladder and burning on urination	Yes	North Atlantic Area	Calculus over trigone of bladder	Stricture of urethra and swollen right testicle	Tall and Thin	Laminectomy Cystotomy
Alkaline	Compression Fractures of D-3 & D-4 Frac. rt. Femur and acetabulum	Triple Phosphates	2–4-w.b.c.	113	Plaster Jacket	1. Hematuria	Yes	California USA	No IVP performed at time stone passed	Paraplegia still	Tall and Thin	Laminectomy
7 cases Alkaline 4 cases weakly acid 1 acid			Low 76 days High 622 days Av. 276 days			1. Pain outstanding complaint in 10 cases 2. Burning on urination 3. Hematuria 6 cases	11 Patients had Sulpha	6 Atlantic 5 Pacific 1 U. S.				

tenderness upon deep palpation. On the basis of Flocks classification, much can be learned from the cases shown in the chart below. The following twelve cases are those with fractures complicated by urinary calculi:

Certain pertinent facts are immediately obvious upon examination of the above cases:

1. In seven of the twelve cases, the urine was definitely alkaline; in four cases it was weakly acid, and in one instance, it was noticeably acid.

2. Examination of the crystals of the urine indicate that triple phosphates were present in four cases, which indicates an infectious process. Six cases demonstrated calcium oxalate, calcium carbonate, and phosphate. The other two cases demonstrated either oxalate or urate crystals.

3. Examination of the white blood cells in the urine revealed that in only six instances was the pyuria marked. In one of this group, the calculi were bilateral. The remaining six cases were not impressive in their urinary white blood count. Our interpretation of the latter fact, is that urinary stones may occur in the absence of infection in the urinary tract.

The number of days of immobilization prior to the appearance of kidney stones is somewhat variable. The shortest time for the occurrence of urinary stones was seventy six days, and the maximum time for the occurrence of urinary stones was 622 days after fracture. The group of twelve cases averaged 276 days. Another factor, which is of interest, is that no stone occurred when the individual became ambulatory. All stones were manifest while the patient was still recumbent. In an examination of the symptoms, pain was the outstanding complaint in ten of the cases. The second most frequent symptom was hematuria, which was macroscopic in six of the cases. The third outstanding symptom was burning on urination. A chill was present in only one of the twelve cases reported. This patient's urine, however, was not infected. Urinary stones

occurred on the right side fifteen times and five times on the left side, with the two remaining stones in the trigone of the bladder, and the ureterovesical junction. Sulfa therapy was administered in eleven of the twelve cases. However, no sulfa stones were discovered in this series.

Six of the cases were from the Atlantic area, five from the Pacific, and one from California. This would tend to indicate that the climatic condition does not play a major part in the formation of urinary calculi.

Examination of the sites of the calculi would seem to indicate that in ten instances the process was early because of the fact that the stones were found in the calices, pelvis, or upper ureter. In only two cases were these stones found in the bladder. Such high calculi should be more amenable to therapy.

The individuals as a group were classified as either thin or stocky. Three of the group were stocky, and the other nine were thin. No importance has previously been attached to this fact but when it is recalled that nephroptosis is more common in the tall and thin individual such a point may be worthy of further investigation.

TREATMENT

It is the opinion of the authors that the therapy and prophylaxis should be directed toward:

1. Improving the drainage of the kidney by daily changes of posture, by exercising the uneffected parts, and keeping infection at a minimum. With the personnel provided by the physical training program of the Navy it has been no problem to maintain the muscle tone and thereby provide adequate circulation.

2. Diet is considered to be of some significance. A high acid ash diet maintains the urine in an acid state and prevents the formation of stones which occur in an alkali media.

3. In the event that the urine still remains alkaline, it is suggested that ammonium chloride 8 to 10 gr. three times

a day be given to supplement the acid ash diet. It is recommended that the hydrogen ion concentration be maintained at 5.5. This may be controlled by daily urinalysis.

4. Fluids should be forced at all times in order to prevent stasis and to minimize the dehydration which occurs in hospitals in winter time, and outdoors in the summer time.

5. Every effort should be made to combat staphylococcic, streptococcic and proteous infection.

6. Sulfathiazole and sulfadiazine both may be used to combat infection as the case warrants. Penicillin is of no use in strictly Proteus infection.

7. Catheterization should be discouraged, as not infrequently, it will result in an ascending infection of the genitourinary tract.

8. Monthly flat plates should be taken of the abdomen to detect early calcification in kidneys and bladder.

CONCLUSION

A discussion has been made of twelve cases of urinary calculi which complicated fractures. An effort to point out the pitfalls which may be encountered was made, in order to anticipate and to treat patients with this misfortune. The advent of such appliances as the Haynes' Splint, Stader Splint or Roger Anderson or other appara-tus which facilitates early activity and minimal recumbency should further assist in preventing stasis and prolonged fixation of the extremities. It is hoped by the authors that the above paper may be of some assistance in preventing the occurrence of recumbency calculi.

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SPLENECTOMY FOR TRAUMA

PRACTICAL POINTS IN SURGICAL TECHNIC

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SPLENECTOMY is not a common operation in temperate climates. Partly because of this, and partly because it sometimes is a difficult and hazardous surgical procedure, it is a favorite choice of senior surgeons and professors of surgery. Consequently, it is not uncommon, even in the larger clinics, for well qualified surgeons to complete their training with little or no personal experience with this operation. While it may be a sound policy to concentrate the surgery of those spleens that are greatly enlarged, or are associated with certain blood dyscrasias, in the hands of the highly experienced few, the removal of the ruptured spleen is an operation which must, perforce, be performed by the comparatively inexperienced man. This is particularly true of military surgery, in which injuries of the spleen are encountered more frequently than in civilian practice.

The removal of the ruptured spleen is not a difficult procedure if certain anatomical facts are appreciated by the surgeon. This presentation of the technic has been prompted by the sight, on more than one occasion, of surgeons of considerable experience struggling in the depths of the abdomen in an effort to secure the entire gastrosplenic and lienorenal ligaments in a single pedicle clamp, and by the realization that a number of able surgeons appear to be unaware of the basic contributions of Balfour[1] to this field.

SURGICAL ANATOMY

The splenic pedicle is composed of three separate layers well described by Henry[4] as an "anatomical sandwich." An understanding of the nature and relationship of these layers is an essential prerequisite to a well ordered splenectomy. From before, backward, these are: (1) *The presplenic fold*, a thin, double peritoneal fold extending from the great omentum to the lower pole of the spleen. (Fig. 10.) In the small, previously normal spleens of acute trauma, it is an inconsequential structure often divided under the mistaken notion that it is a peritoneal adhesion. It may contain a few small veins. In enlarged spleens this layer may become a greatly thickened and formidable barrier;[3] (2) the *gastrosplenic ligament*, a double fold of peritoneum containing branches derived from the left gastro-epiploic artery and vein. This fold extends from the stomach to the spleen, to which it is attached along the anterior margin of the hilum from upper to lower pole. It holds the stomach in close proximity to the upper pole of the spleen; (3) *the lienorenal ligament*, a double fold of peritoneum containing the splenic artery and vein and the tail of the pancreas. These layers are represented diagrammatically in Figure 1A.

Approached from in front, the entire pedicle, with its three layers and five peritoneal reflections, lies between the operator and the splenic artery, which in the case of traumatic rupture of the spleen is the immediate goal. From behind, however, only a single peritoneal covering and the tail of the pancreas intervene between artery and surgeon. Actually, in the small, previously normal spleens encountered in acute trauma this posterior reflection is a delicate structure often torn in delivering the spleen, and the pancreas rarely extends to the end of the pedicle. So once the spleen is delivered and the pedicle viewed from behind, the splenic artery is completely exposed and can be secured at once. This fragment of surgical anatomy was pointed
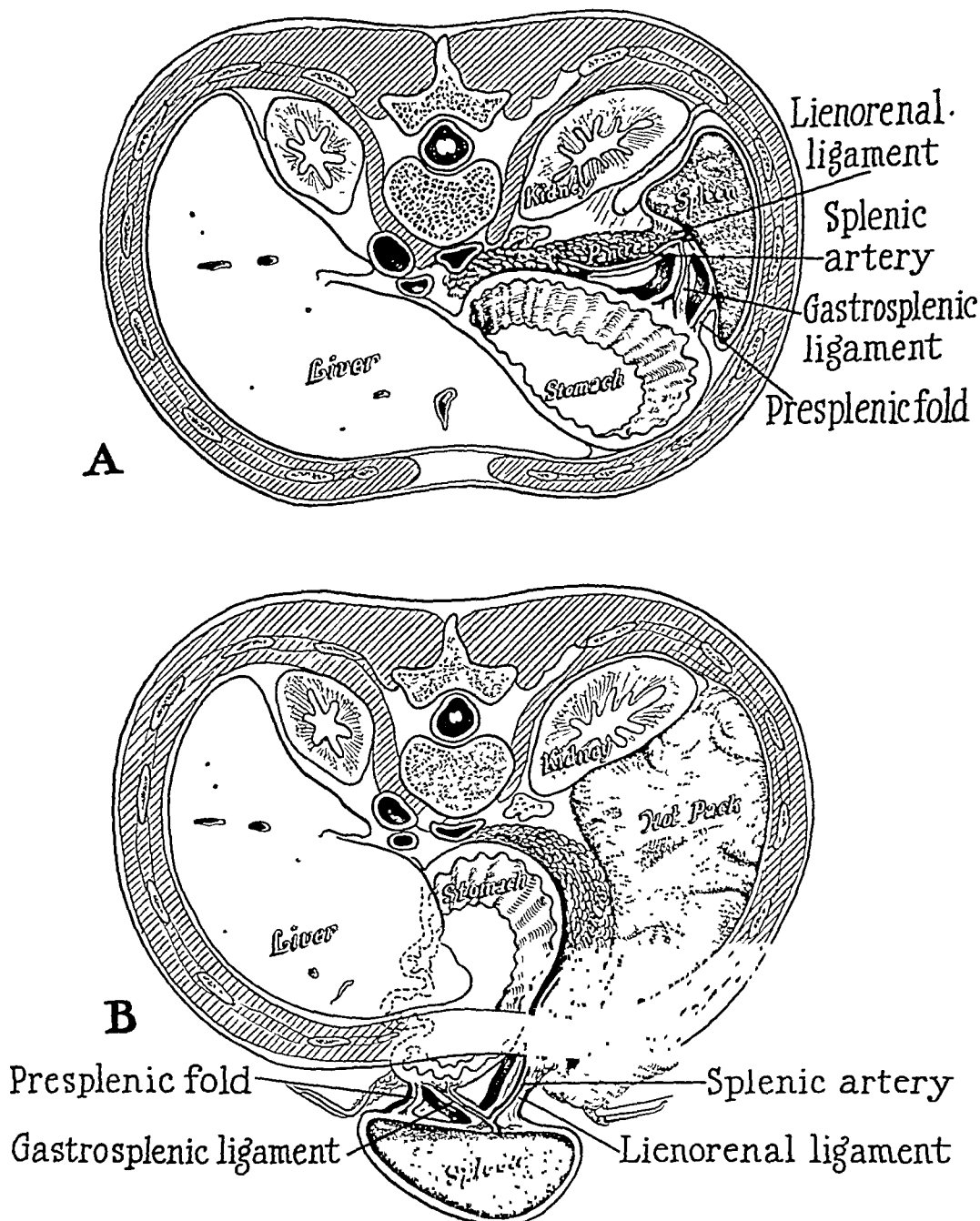
Fig. 1. a, diagrammatic representation of the surgical anatomy of the spleen. The three layers of the splenic pedicle bar the surgical approach to the splenic artery from in front. b, diagrammatic representation of the anatomical relationship after delivery of the spleen and insertion of a gauze pack. From behind only the tail of the pancreas and a thin peritoneal covering intervene between artery and surgeon. Actually, as described in the text, in most instances the artery is completely exposed in its distal portion by this maneuver.

out and beautifully illustrated by Balfour over two decades ago.[1] It is illustrated diagrammatically in Figure 1B.

torn completely from its pedicle, this route may be the most expeditious way of securing the retracted bleeding vessels.

Sandbag
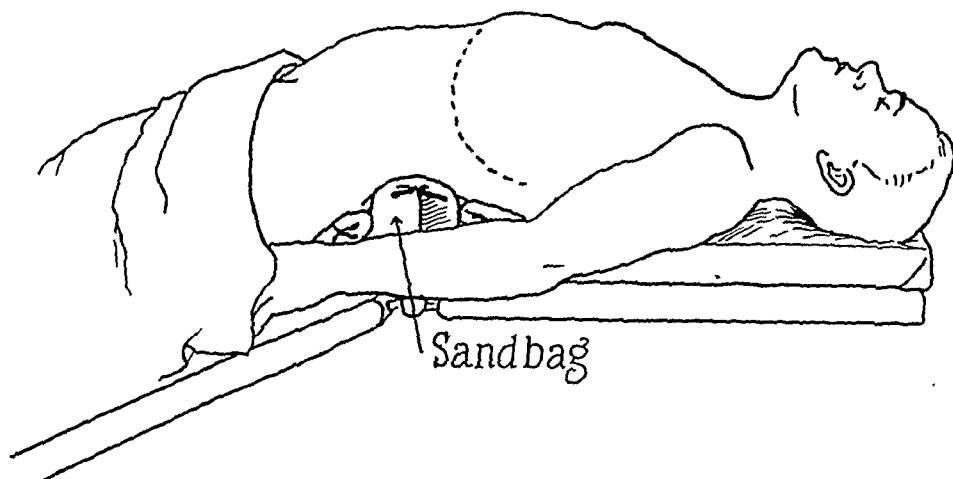
FIG. 2. Optimum position for splenectomy.

Four attachments may interfere with easy mobilization of the spleen; (1) The posterior layer of the lienorenal ligament may be fused retroperitoneally; (2) the upper fused edge of the gastrocolic and lienorenal ligament may be attached to the diaphragm (phrenicosplenic ligament); (3) there may be adhesions between spleen and diaphragm; or, (4) between spleen and splenic flexure of the colon (lienocolic ligament). Although in certain cases of enlargement of the spleen these attachments may become quite vascular, normally they contain no major blood vessels.

One additional anatomical feature to be kept in mind is the long course of the splenic artery along the upper edge of the pancreas, which fact permits it to be exposed through the lesser peritoneal cavity some distance from the spleen. This is of considerable importance in dealing with very large spleens since it permits control of a major portion of the blood supply before attempting to mobilize the spleen.[2] This fact is not of great importance in the surgery of the ruptured spleen when the primary purpose is to secure the bleeding vessel, and the small size of the spleen makes delivery and exposure comparatively easy. Rarely, as will be pointed out later, in cases in which the spleen has been

DIAGNOSIS

There may be considerable variation in the severity of the symptoms, depending upon the degree of injury. If the trauma is sufficient to produce immediate rupture and the spleen is the only organ injured, the diagnosis is not difficult. A history of a blow on the flank, followed by pain in the left upper quadrant, later extending throughout the abdomen, increasing evidence of peritoneal irritation, pain in the region of the left shoulder, dyspnea, and progressive shock, are characteristic. However, a contusion of the spleen can be produced by injuries so trivial as to be forgotten by the patient, and actual rupture can be delayed for periods varying from several hours to as long as a week or ten days.

If there is an extensive contusion of the muscles of the flank and abdominal wall, multiple fractured ribs on the left, fractures of the transverse processes of the lumbar vertebrae, and a contusion of the kidney, it may tax the skill of the most experienced clinician to determine the extent of injury to the spleen. In such cases, careful, repeated examination of the abdomen is necessary to establish a diagnosis. Recurrence of shock after adequate re-

placement of blood, together with increasing evidence of peritoneal irritation or signs of shifting dullness in the abdomen may be the first conclusive evidence of an intraperitoneal injury. Diagnostic abdominal paracentesis has been recommended. This procedure is not without risk, and the results obtained by it are by no means entirely reliable.

PREOPERATIVE PREPARATION

The recorded mortality in rupture of the spleen varies between 30 and 40 per cent.[5] The amount of blood loss in these cases may be staggering and inadequate replacement is probably the most important single contributing factor to the high mortality. Adequate shock therapy is, therefore, the most essential preoperative preparation. Large amounts of whole blood are required to maintain a normal circulatory state. Whole blood, rather than, or in addition to plasma is vitally important. Complete reliance upon plasma as a replacement fluid in cases of severe hemorrhage in which extensive surgery is necessary has been singularly disappointing.[3]

One additional preoperative measure of considerable value, is to pass a Levin tube into the stomach and leave it *in situ* during the operation thus assuring that the operative field is not obscured by a large dilated stomach.

OPERATIVE TECHNIC

The optimum position of the patient is shown in Figure 2. The table is broken slightly at the level of the costal margin, anteriorly, and the body rotated slightly toward the right and supported in this position by a sand bag in the loin. This elevation on the flank permits a lateral T-shaped extension of the left rectus incision in difficult cases. (Fig. 3.)

The abdomen is opened through a long paramedian left rectus muscle-splitting incision. This should extend up to the costal margin and below to the umbilicus, or a little beyond. Many surgeons prefer

an oblique incision for splenectomy, but in dealing with the ruptured spleen the left rectus incision is preferable because it
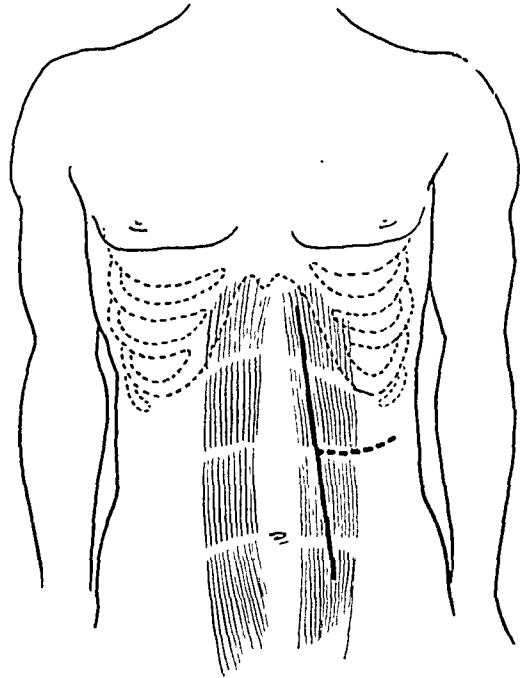
FIG. 3. Incision for splenectomy. Perference for the left rectus incision rather than an oblique subcostal approach is discussed in the text. The T-shaped lateral extension is rarely necessary.

can be made more quickly and easily, permits better exposure of the rest of the abdomen in case of associated injuries to the liver or intestines, and is entirely adequate for removal of the small previously normal spleen. Rarely, if the pedicle is lost, or the spleen torn completely from its pedicle, the T-shaped extension as shown in Figure 3, may be needed to provide more complete exposure. The transpleural approach to the injured spleen is recommended only when there is an associated injury to the chest which requires an immediate left thoracotomy.

Once the abdomen is opened, exploration completed, the diagnosis confirmed, and the immediate field cleared of blood, the spleen should be delivered into the wound and the bed firmly packed with a large, warm, moist gauze pad. In delivering the spleen it is useless to attempt to pull it out by the slippery lower pole. The hand must be advanced along the free lateral aspect

of the spleen gently separating diaphragmatic adhesions with the fingers. (Fig. 4, Insert A.) Once over the upper pole with

obliterated, further gently freeing with the fingers is necessary.

There is always a small amount of bleed-
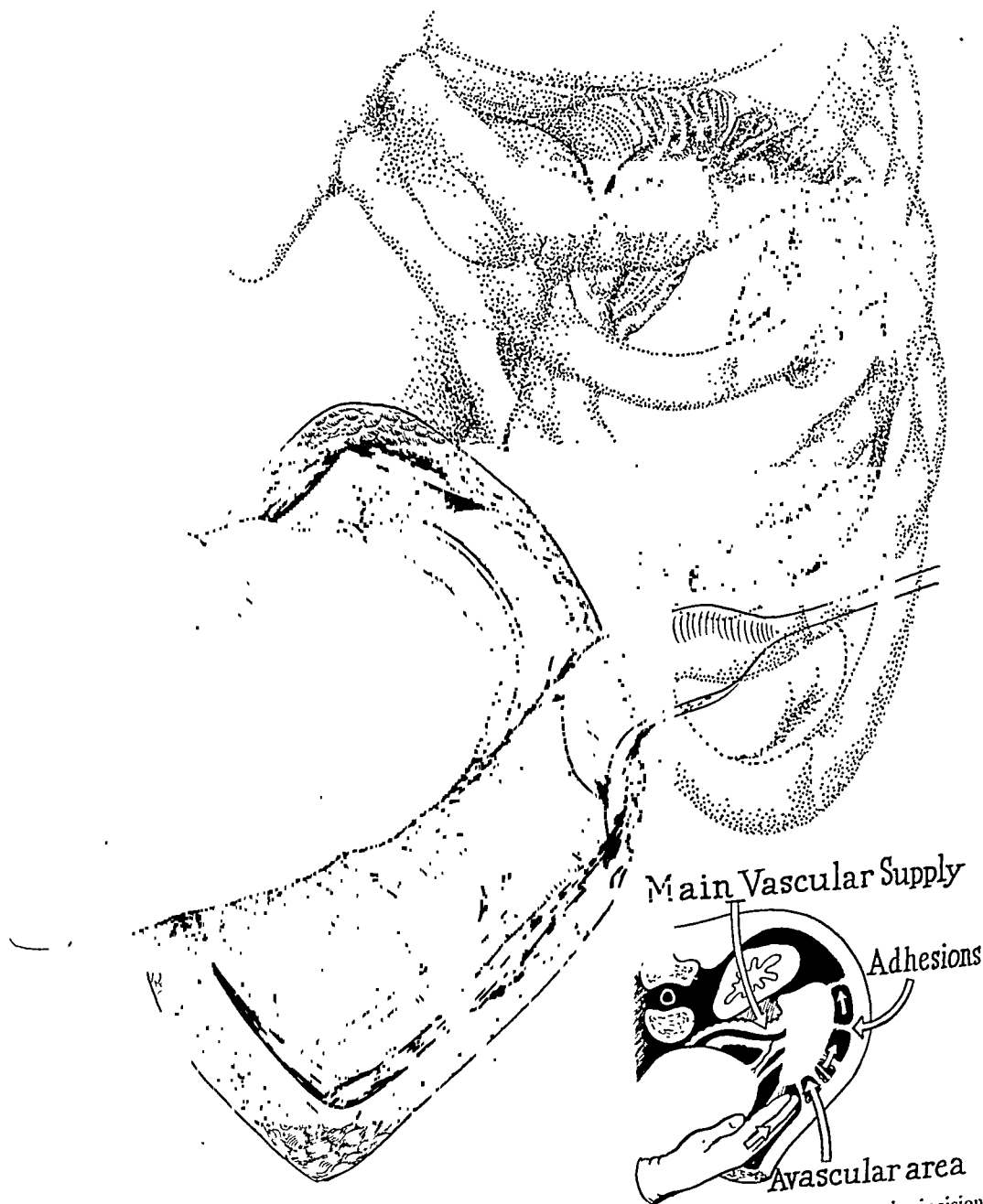
FIG. 4. Diagrammatic representation of the depth at which the spleen lies in relation to the incision. The operator's hand must reach above the upper pole and "push" the spleen down rather than try to grasp the tip of the lower pole. The insert shows points of fixation which may have to be gently separated by the fingers and the direction in which the hand should be advanced to avoid vascular areas.

the posterolateral margin free, the spleen should be *pushed* toward the wound. If the posterior layer of the lienorenal ligament is free, delivery is easier. If this layer is

ing from diaphragmatic adhesions or retroperitoneal attachments after the spleen is delivered. As Balfour[1] has pointed out, the use of a huge gauze pack satisfactorily

controls this oozing even in the case of large adherent spleens. In the small spleens of acute trauma, therefore, no time

colon in freeing what appears to be just another adhesion.

How far distant the spleen lies in rela-
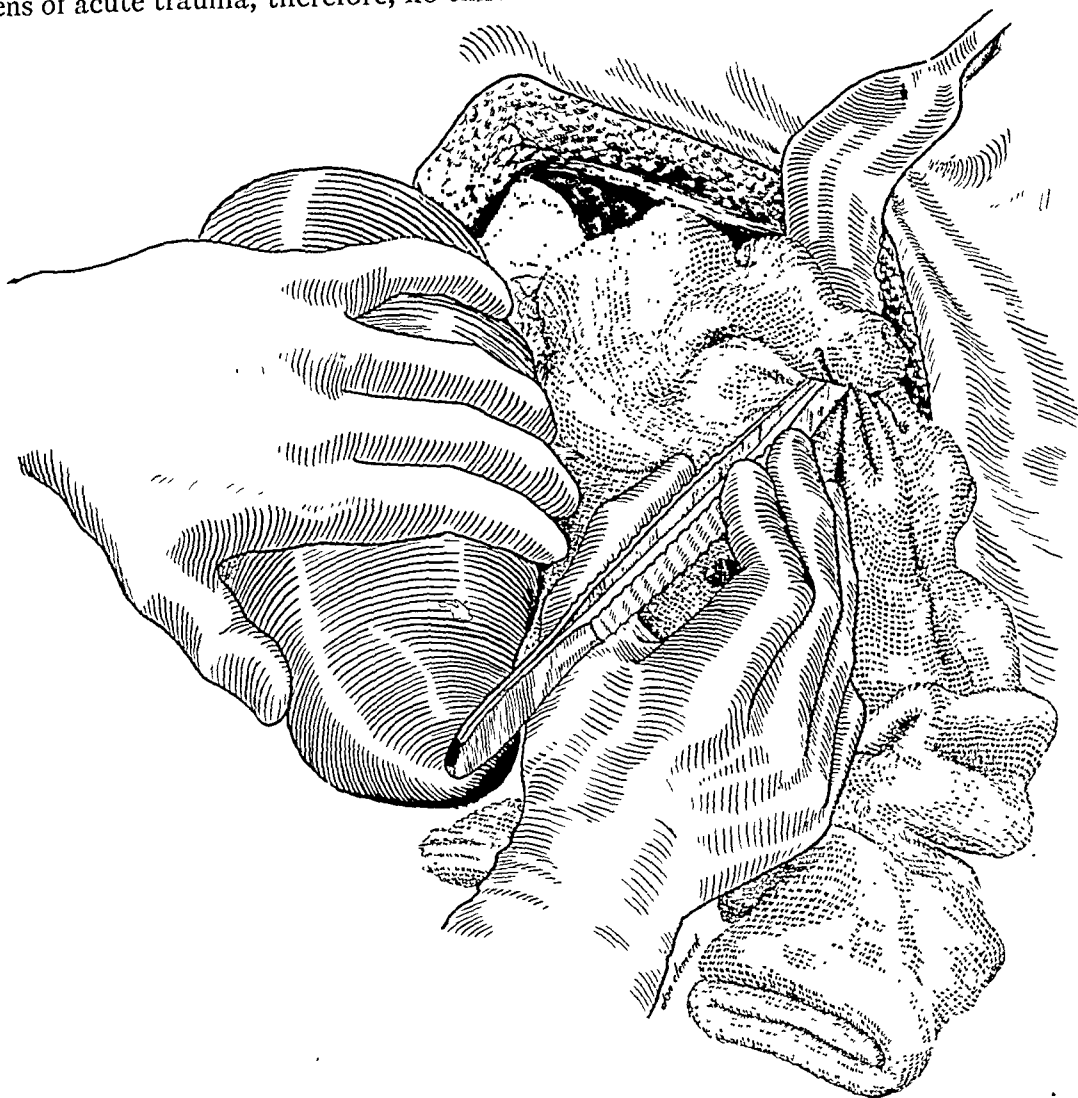
FIG. 5. The spleen is delivered and the splenic bed is being packed with a large, warm, moist gauze pad. This controls oozing from the splenic bed and diaphragmatic adhesions. The final position of the pack is shown in Figure 1B.

need be lost in freeing the comparatively avascular adhesions or attachments which may be encountered. Usually, these can be gently separated by the fingers. At times it may be preferable to divide the posterior peritoneal reflexion with scissors, but this is time-consuming and usually not necessary. The lienocolic ligament is readily divided with scissors during or just after delivery of the spleen. This attachment of the spleen is easily overlooked however, and care must be taken not to injure the

tion to the wound is shown diagrammatically in Figure 4. Despite this, the splenic pedicle is sufficiently mobile to permit delivery. The only danger is the possibility of tearing large veins in the lienorenal ligament, or pulling a badly fractured spleen completely away from its pedicle. This should rarely, if ever, happen if care is exercised. If these accidents just mentioned should occur, there is no cause for serious alarm as the situation can readily be controlled.

As soon as the spleen is delivered it is held by the operator's left hand, and the cavity firmly packed with a large, warm,

pancreas off the posterior aspect of the pedicle as indicated in Figure 6.

The spleen is now turned over to the
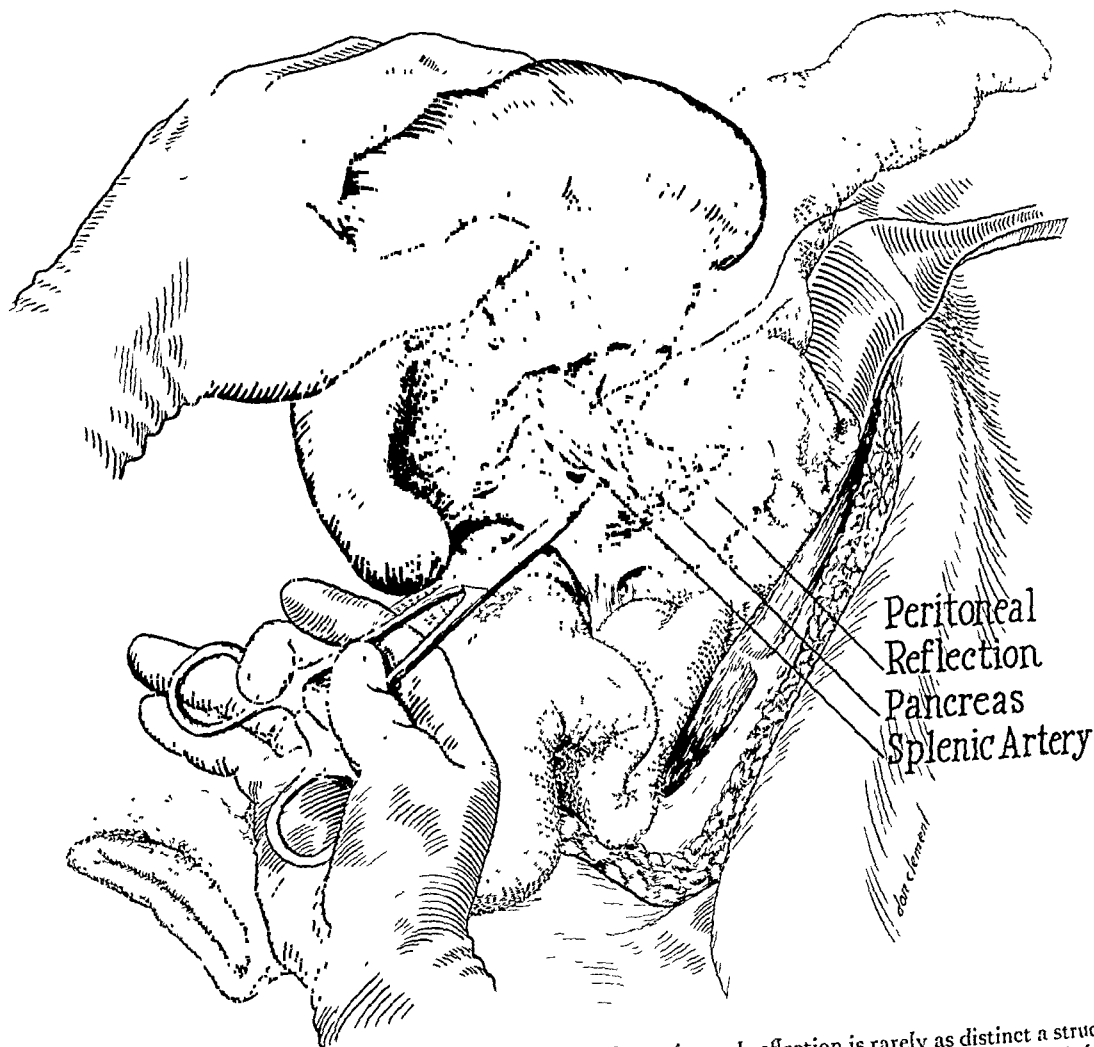
FIG. 6. The exposure of the splenic pedicle from behind. The peritoneal reflection is rarely as distinct a structure as it appears here. Also, it is rarely necessary to dissect the pancreas off the posterior aspect of the pedicle as it usually does not extend down as far as represented. However, access to the main branches of the splenic artery can be obtained as easily as represented.

moist gauze pad. (Figs. 1B and 5.) Inspection of the posterior aspect of the pedicle will now reveal the splenic artery, or its major branches directly accessible. (Fig. 6.) These are secured at once with ligatures, and the remainder of the operation can be done quite leisurely. It should be noted that these vessels in the lienorenal ligament are isolated individually and tied under direct vision. No attempt is made to divide the vessels or pedicle at this point. Occasionally, in order to expose the artery it may be necessary to dissect the tail of the

left, exposing its anterior margin and the dissection of the presplenic fold and gastrosplenic ligament undertaken. (Fig. 7.) The former usually amounts to a mere wisp of tissue, and is easily severed. It may be absent. The latter requires division by careful isolation and ligature of vessels. With two fingers beneath the gastrosplenic ligament, separating it from the lienorenal ligament, it is very easy to isolate, clamp, and divide it in convenient bites which include major vessels, as shown in Figure 7. The proximity of the stomach to the

spleen at the upper pole calls for this careful dissection of the gastrosplenic ligament. Actually, it takes only a few minutes to

divided any attempt to clamp *en masse* the main pedicle is very likely to result in injury to the stomach.
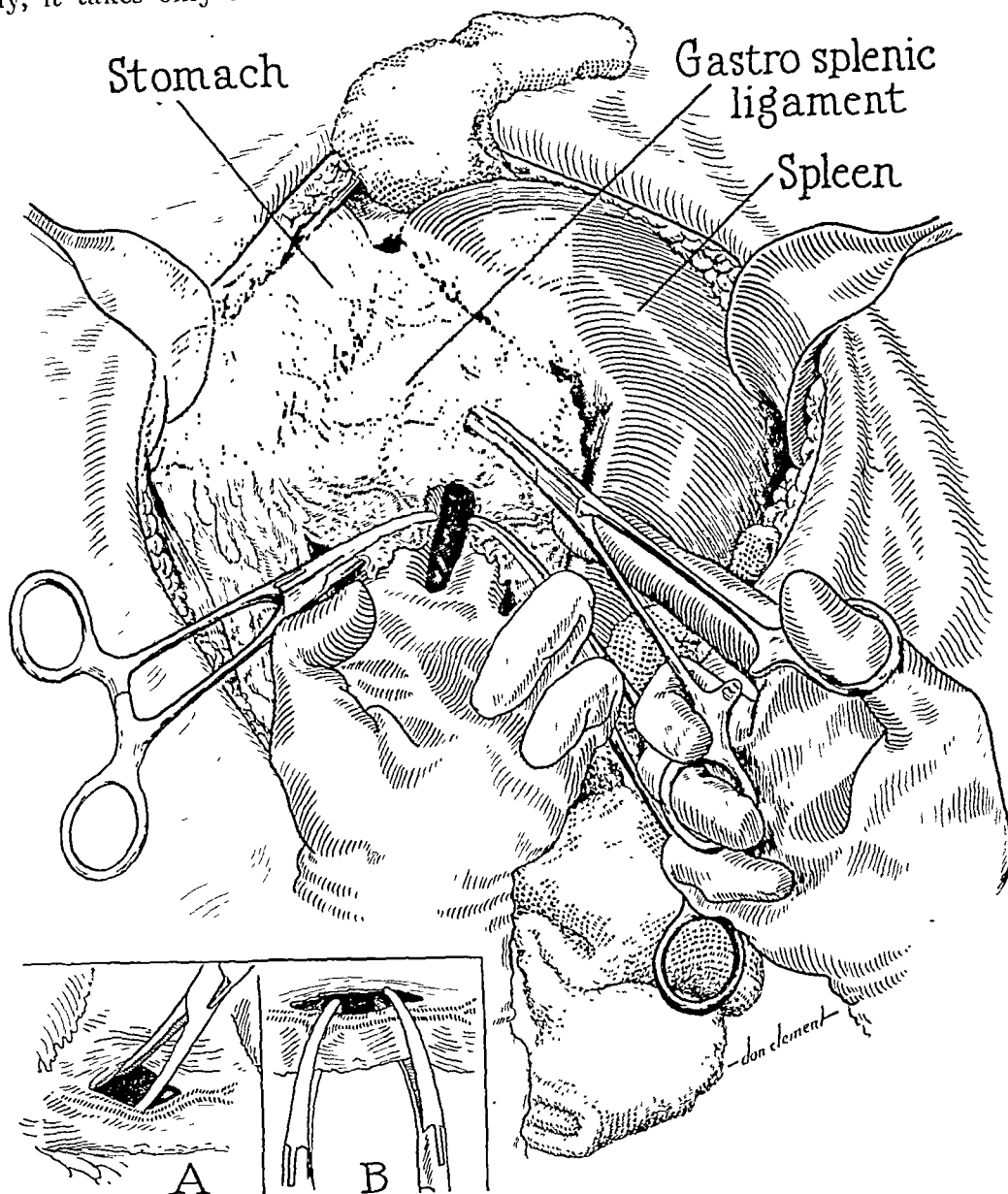
FIG. 7. Division of the gastrosplenic ligament. Two fingers separate it from the lienorenal ligament below. Division of this structure is easily accomplished in small bites of tissue which include the large vessels, as shown in the inserts. This careful dissection is necessary to avoid injury to the stomach which may lie directly against the upper pole.

accomplish. This now leaves the spleen attached only by its true pedicle, the major vessels of which have already been secured by ligature. It is now possible to divide these under direct vision with no possible danger of wounding the stomach. (Fig. 8.) Until the gastrosplenic ligament has been

After inspection of the retracted pedicle, to be certain that bleeding is controlled, the large pack is removed and the bed of the spleen and the diaphragm inspected for bleeding points. Usually, all ooze has ceased by this time, but if not it is amazing how easy it is, once the spleen has been

removed, to isolate, clamp, and tie a few individual veins in this area.

The problem of what to do if a clamp

adequate the left rectus incision should be extended to the left by a T-shaped extension. (Fig. 3.) The loose fragment of spleen

Divided
Gastrosplenic
ligament

Splenic Artery
Lienorenal
Ligament

FIG. 8. The gastrosplenic ligament has been divided. The spleen is attached now only by the true pedicle (lienorenal ligament), the main artery of which has already been tied. (Fig. 6.)

slips, the pedicle is lost, and uncontrolled bleeding is encountered, requires consideration. Actually, this should not happen if the vessels are secured individually according to the technic just described. Rarely, a badly fractured spleen may be pulled off from the pedicle, or, as in a case seen by the author, be entirely separated from the pedicle by the initiating trauma. In such cases, unless the exposure is unusually

is removed, the remainder of the spleen delivered and the cavity firmly packed with a huge gauze pad. By pressure on this pad, bleeding will be controlled sufficiently to permit a normal circulatory state to be maintained by a continuous blood transfusion. The main splenic artery should then be isolated by exposing it where it courses above the pancreas through the gastrocolic ligament. (Fig. 9.) This approach should be

made some distance away from the spleen proper, as if one were opening the lesser sac in preparing to free the greater curva-

At the conclusion of the operation all blood and blood clot should be removed from the peritoneal cavity. Since blood loss
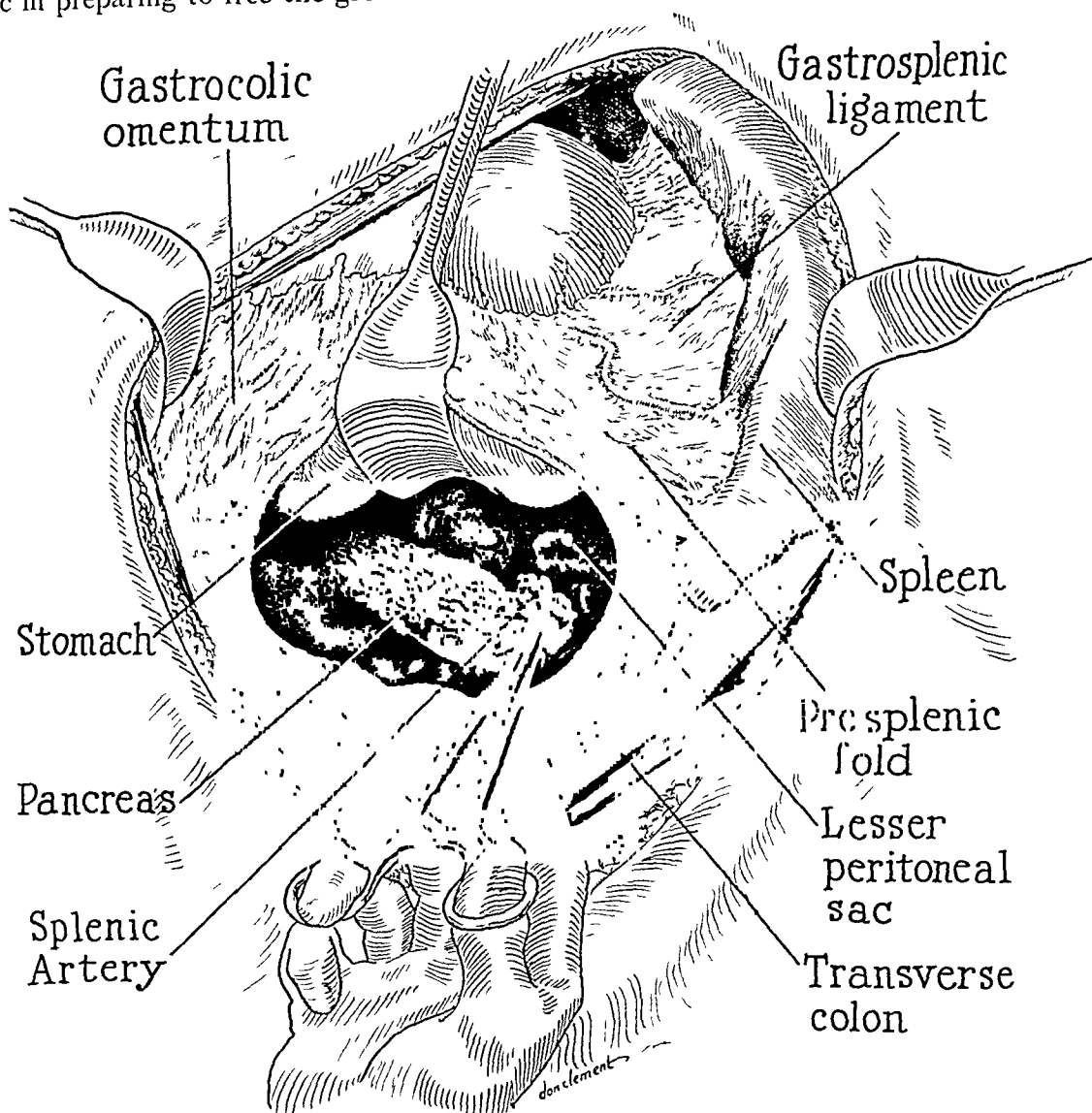
FIG. 9. Approach to splenic artery through the gastrocolic ligament. This route is most expeditious if the splenic pedicle is lost, or the spleen is torn completely from its pedicle by the initiating trauma.

ture of the stomach for gastrectomy. Here one obtains easy access to the lesser sac without the troublesome bleeding, adhesions, or peritoneal reflections encountered directly over the gastrosplenic ligament. Once the lesser sac is opened, by working to the left, the tail of the pancreas and the retracted bleeding pedicle are readily identified. (Fig. 9.) Once this has been secured, the remainder of the operation can be conducted as previously described.

is so readily replaced by transfusions there is no sound basis on which to recommend deliberately leaving blood or blood clots in the peritoneal cavity. Closure should be done in layers and supported by retention sutures.

POSTOPERATIVE CARE

Shock therapy should be continued after operation until a normal circulatory state is maintained without it. In general, it is

gratifying to see how well these patients do postoperatively. Atelectasis of the left lower lobe of the lung is likely, and efforts should be directed toward its prevention. Following removal of the ruptured spleen there is normally a persistent, slight thrombocytosis and leucytosis with a relative lymphocytosis. There is no anemia and no detectable physiological abnormalities.

The development of accessory spleens scattered throughout the abdomen may occur after traumatic rupture of the spleen.[5] This phenomenon may play a compensatory rôle.

Splenectomy need not constitute a contraindication to military service.

SUMMARY

A technic of splenectomy for trauma is presented in detail. Attention is called to the fundamental contributions of Balfour to this field. Certain features of the pre- and postoperative care are discussed.

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Announcement: The American Association for the Surgery of Trauma announce that plans have been formulated for their annual meeting to be held June 26, 27, 28, 1946, at the Plaza Hotel, San Antonio, Texas.

COMPLETE DUODENAL OBSTRUCTION IN THE NEWBORN*

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COMPLETE obstruction of the duodenum in the newborn constitutes a grave surgical emergency. A prompt diagnosis combined with remedial surgery offers the only opportunity for survival.

Before corrective therapy can be effectively employed one must have a clear understanding of the manner in which various anatomic abnormalities can and do effect these troublesome occlusions. The provocative mechanisms can be conveniently grouped into those factors effecting an intrinsic occlusion and those producing extrinsic compressions of the bowel lumen.

The intrinsic occlusions represent a failure of the duodenum to form a patulous lumen. During a certain phase in its embryological development the intestines consist of a solid cord. Later, the central cells disintegrate and form large vacuoles, and as these vacuoles coalesce, the intestinal cord becomes tubular. Faulty tabualization results in a variety of congenital anomalies. If the entire duodenum remains as a solid cord, the condition is known as complete congenital atresia. Occasionally, a partial or segmental vacuolation occurs causing a portion of the duodenum to be normal while other segments have no lumen. In rare instances the entire duodenum may be patulous except for a small transverse diaphragm which effectively inhibits the flow of duodenal fluids into the jejunum.

The extrinsic obstructions are caused by external compression of a normally developed duodenum.[8] Rotation of the midgut may be accompanied by the formation of strong bands of cicatricial tissue around the descending and transverse segments of the duodenum so as to compress its lumen. Occasionally, the cecum may lie directly over the duodenum and exert sufficient external pressure to obliterate the duodenal lumen. Faulty fixation of the mesentary of the small bowel frequently obstructs the intestine at the duodenal jejunal angle.[8] All of these conditions, whether of intrinsic or extrinsic origin, do produce acute obstructions of the duodenum.

SYMPTOMS

The obstruction and the ensuing pathologic changes are well established by the time the child is born as they may occur before the fifteenth week of fetal life. Vomiting is the cardinal symptom. It begins shortly after the first feeding and becomes progressively worse until it assumes a pernicious nature. As a general rule the occlusions lie below the ampulla of Vater, hence the vomitus is stained with bile while the meconium is acholic. Should there be a complete atresia of the duodenum or if the obstruction is situated at the level of the ampulla of Vater, neither the regurgitated food nor the stools contain biliary pigments. In the suprapapillary obstructions the acholic vomitus consists of ingested foods mixed with gastric secretions while the meconium is stained with bile.

Whenever the obstructive agent interferes with the free flow of bile into the duodenum the infant becomes jaundiced. While icteric changes in the newborn usually portend no serious pathologic condition they may signify serious biliary obstructions. This is evidenced by the fact that one of our patients was treated for icteroneatorum for six days and it required an autopsy to convince the physician that

a complete duodenal atresia was the sole cause of the jaundice.

Distention is invariably present and is always limited to the epigastric area while the lower abdomen remains flat. This significant clinical sign is produced by the failure of ingested air and gas forming bacteria to pass beyond the obstructed duodenum, so that the small intestines and the colon remain in a collapsed state. Peristaltic waves may be seen crossing the epigastrium from the left to the right side.

Dehydration combined with inability to absorb foods, vitamins, and essential electrolytes, soon lead to anemia, loss of tissue turgor, progressive inanition and mild hyperthermic reactions.

DIAGNOSIS

While careful observation and repeated examinations during the first twenty-four hours of life may suggest the diagnosis of an acute intestinal obstruction, it requires roentgenologic studies for accurate localization of the occlusion. Simple scout films of the abdomen may demonstrate a gaseous distention of the stomach and duodenum while failing to outline gas bubbles in the jejunum, ileum or colon. (Fig. 3.) One should always inquire whether an enema has been given prior to the x-ray examination, for if air has been introduced into the colon it cannot be differentiated from ingested air and may lead to an erroneous conclusion of a patent intestinal tract. Films should be taken in an anteroposterior, anterolateral positions and with the child in the inverted and upright postures. If the gas bubbles do not change their position, a fixed congenital deformity can be assumed. Neuhauser[7] found that the obstructed duodenum may rupture during neonatal life thus liberating the sterile meconium into the peritoneal cavity. He found that in such instances the meconium contains depositions of calcium which are readily detected by roentgenographic studies. Such deposits were confined to the proximal segment of obstructed gut and to the intraperitoneal areas containing the meconial clumps.

When contrast media are used for x-ray studies, care must be exercised to prevent the aspiration of this material, as the swallowing, coughing and expectorating reflexes of these frail infants are very immature. This hazard can be greatly minimized by injecting the barium mixtures through a small Levine tube which has been previously passed into the gastric lumen. The barium clearly delineates the dilated stomach and megaduodenum thereby effectively localizing the obstruction. A differential diagnosis between complete obstruction, and hypertrophic pyloric stenosis can be readily made by progress films, for in the latter a small amount of barium invariably passes into the jejunum. After completion of the x-ray studies it has been our practice to aspirate the barium mixture by gently lavaging the stomach. This not only minimizes the dangers of aspiration pneumonia but facilitates respiration by relieving the gastric distention. Detection of a faulty rotation of the midgut can be made by employing a barium enema. The abnormal position of the cecum is diagnostic. Such studies should never be attempted unless the stomach and duodenum have been decompressed as the resulting colonic distention might seriously embarrass respirations. Ladd[4] affirms that the information acquired from the roentgenologic studies of the colon is not worth the risk it entails as the operative exposure is the same for all types of duodenal obstructions.

TREATMENT

It is imperative that these frail infants be thoroughly prepared for the traumatic insults of surgery. Operations which were formerly prohibitive can now be executed with comparative safety because of this physiological rehabilitation. It is essential that the fluid and electrolytic balance be changed from the negative to a positive phase, taking care not to overburden the immature circulatory and renal systems.

Ladd and Gross[4] advise that all replacement fluids should be given in small amounts and at regular intervals. The thighs, buttocks and flanks afford excellent receptacles for non-irritating fluids. In the presence of extreme dehydration solutions of 5 per cent glucose containing cevitamic acid, vitamin B complex, vitamin K and essential ammino acids are administered by the intravenous route.

Transfusions of whole blood are invaluable in combatting the existing anemia and reinforcing the babies inadequate immunological reactions. It is well to remember that a hemoconcentration due to a dehydration can give a normal blood count when in reality a serious anemia exists.

Constant decompression of the dilated stomach can be readily accomplished by using the indwelling Levine tube. This permits the atonic gastric and duodenal walls to regain their normal tone thus expediting subsequent surgical correction.

Many of the postoperative pulmonary complications come from the unwise selection of the anesthetic agent. Ether irritates the pulmonary tree thereby producing thick tenacious mucus which these babies are unable to cough up and expectorate, thus predisposing to atelectasis. Theoretically, the infiltration of 1 per cent solution of novocaine would be ideal but we have found that it does not provide adequate muscular relaxation for careful exploration and the added trauma necessary to prevent eviscerations adds to the operative shock. Brown[1] maintains that these tiny infants do not tolerate too much novocaine and he reports examples of lethal poisoning from overdosage. Our anesthetist, Dr. Scott Smith,* believes that cyclopropane is a safe and useful agent. During the past months he has used cyclopropane in eight infants, varying from fifteen hours to two weeks of age, who have undergone operations for hypertrophic pyloric stenosis or duodenal obstructions. Whenever complete

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muscular relaxation has been essential he has supplemented cyclopropane anesthesia by administering curare (intocostrin-Squibb) with the most pleasing results. In every instance the babies were awake at the termination of the operation and all reflexes were active. Such agents, however, must be administered by an expert.

The primary objective of every operation is to relieve the obstruction in the quickest and safest manner possible.[6] Unfortunately, procedures which are applicable to adults, such as enterostomies and Mikulicz decompressions, cannot be used in infants because of the profound physiological disturbances which they produce. Peritonitis is common with these operations as the immunoilogical defenses are not fully developed. Reconstructive measures should aim to divert the essential digestive ferments into those segments of the intestinal tract where nature intends them to function. The more closely this can be realized the less severe will be the postoperative digestive dysfunctions.

When confronted with a complete atresia of the duodenum one must relieve the gastric obstruction and decompress the obstructed extrahepatic bilary radicals. This requires two separate procedures. We have employed both the antecolic and the posterior gastrojejunostomies in relieving the duodenal stasis. The antecolic type, as popularized by Lahey,[5] can be executed more rapidly and with less trauma than any other variety and should be used if the infant is in a precarious state. The biliary stasis can best be corrected by performing a cholecystogastrostomy.[2] Fortunately, the distended gallbladder and the dilated stomach are contiguous so no difficulty is encountered in forming a diversional biliary stoma. In such instances we always pull the tip of the indwelling Levine tube through the newly formed cholecystogastric stoma so that it lies within the lumen of the gallbladder.[3] Constant suction keeps the gallbladder decompressed by syphoning off the static bile, thus expediting hepatic recovery. It also diminishes the intracystic

pressure of the gallbladder thus reducing the tension of the stomal suture lines and minimizes the dangers of bile leakage with its resulting peritonitis.

Occasionally, acute obstructions are caused by compressive cicatrical bands which cross the lower end of the descending duodenum or the proximal portion of the transverse segment. In many instances one needs but to divide the restraining bands of scar tissue to establish the patency of the duodenum. If the contents of the proximal duodenum can be manually forced across the obstructed zone no additional surgery is required. We have found, however, that the involved segment may have a concomittant atresia and unless this can be corrected some short circuiting procedure such as duodenojejunostomy or gastrojejunostomy must be employed to relieve the obstruction. All dissections must be done under direct vision so as not to injure the blood supply of the duodenum. The biliary tract is not involved hence requires no attention.

Non-rotation or incomplete rotation of the midgut may produce so much tension on the short superior mesenteric vessels that they effect an acute obstructive angulation of the duodenum at its junction with the jejunum. The superior mesenteric artery may lie in front of or behind the duodenum and be surrounded by obscuring bands of dense adhesions. In some instances releasing the adhesions may correct the kinking but as a rule the vascular pedicle is so short that it still exerts enough pressure to occlude the intestinal lumen. It is obvious that the mesenteric pedicle cannot be elongated so a duodenojejunostomy should be employed. On one occasion we encountered such a situation and had no difficulty in performing the duodenojejunostomy but further exploration revealed that an incomplete rotation of the midgut had caused a partial volvulus so that it required the execution of a Wangensteen operation for non-rotation.[9] These are long, tedious operations and are not well borne by the infant.

The disparity in size between the collapsed segment and the distended loops presents a tantalizing problem in anastomosis. The distal loop appears as a small cord of tissue for the lumen has never been distended by traversing fluids. Wangensteen[9] identifies the lumen by injecting mineral oil into it and manually forcing the lubricating mixture along the collapsed bowel. This not only determines the patency of the gut but distends its walls so that anastomotic procedures can be easily executed. We attempted this technic but were unable to tell when the point of the exploring needle had entered the lumen of the bowel and the injected oil merely extravasated along its muscular coats. It was necessary to open the jejunum and introduce the oil directly into the lumen by means of a small urethral catheter.

When the anastomosis is completed the indwelling Levine tube is pulled through the newly formed stoma so that its tip lies in the distal loop of collapsed bowel. A slow continuous drip of 5 per cent glucose containing all the essential vitamins furnishes adequate nourishment and fluids. If these are well tolerated periodic feedings of a suitable formula or breast milk can be given. Should the bowel become distended continuous decompression soon relieves the annoying distention.

CASE REPORTS

CASE I. *Occlusion of the Duodenum by Extrinsic Adhesions:* B. S. S., a full term baby having a birth weight of seven pounds fifteen ounces vomited its first feeding and every one thereafter. The skin was dry and the turgor of the tissues was poor. We saw her on the fourth postnatal day, at which time she weighed but five pounds six ounces. No attendant, either in the delivery room or in the nursery had observed the passage of flatus or meconium. The epigastrium was distended and tympanitic but no peristaltic waves were visible. A scout film revealed an enormous dilation of the stomach and first portion of the duodenum but no gas was visible in the small intestines or colon. A dilute solution of barium was introduced into

the stomach through a Levine tube but none of the barium passed beyond the transverse duodenum. (Fig. 1.) The barium was im-

FIG. 1. Case 1. The barium has reached the obstructed duodenum. Note the degree of dilatation. No gas bubbles are visible in the small intestines or colon, thus confirming the diagnosis of congenital atresia of the duodenum.

mediately aspirated from the stomach by means of gentle irrigating lavages. A mild flushing of the colon recovered mucoid material devoid of bile pigments, milk curds or squamous epithelial cells. The colon occupied its normal position. It was assumed that we were dealing with an infra-ampullary duodenal obstruction.

The preoperative regime consisted of correcting the dehydration, replenishing the electrolytes, and combatting the existing anemia by repeated transfusions of whole blood. The abdomen was opened under cyclopropane anesthesia. The dilated stomach was further decompressed by continuous suction on the indwelling Levine tube. A dense band of adhesions arising from the root of the mesentery were seen to cross the transverse segment of the duodenum to become attached to the posterolateral parietes. These adhesions were divided thereby liberating the duodenum. However, none of the contents of the upper duodenum could be expressed beyond the

point of obstruction. Whether the prolonged pressure of the extrinsic cicatricial bands had held the walls of duodenum in such firm ap-

FIG. 2. Case 1. A film taken on the fourth postoperative day, thirty minutes after the ingestion of the barium. The degree of duodenal dilatation has diminished. Barium can be seen passing through the newly formed stoma into the jejunum. The rectosigmoid contains barium which had been ingested on the previous day.

position that they had fused, or whether the obstruction presented a regional atresia could not be determined. The collapsed jejunum was opened and found to have a normal lumen as was evidenced by the ease with which 10 cc. of mineral oil could be forced along its lumen. A posterior gastrojejunostomy was accomplished by the usual technic. The indwelling Levine tube was pulled through this stoma so that its tip was placed in the lower jejunal loop. Three hours later feedings of breast milk were given through the tube and pleasing convalescence resulted. Fluoroscopic studies with barium demonstrated a normal functioning gastroenterostomy. (Fig. 2.) This youngster is now one year of age and in the best of health.

CASE II. *Duodenal Obstruction from Faulty Rotation of the Cecum:* B. J., female baby, full term, weighed six pounds ten ounces. The obstetrician commented that the distended

epigastrium made the delivery very difficult. She vomited in the delivery room and had progressive regurgitation with every feeding.

FIG. 3. Case III. A preoperative scout film outlines the dilated stomach and duodenum. The absence of gas in the small intestines and colon is pathognomonic of congenital obstructions of the duodenum.

The vomitus contained bile. Antispasmodic drugs, special formulas, and blood transfusions all failed to halt the dehydration, emaciation and rapid loss of weight.

We saw the baby on its sixth day of life, at which time it was in a very precarious condition. After careful preoperative preparation the abdomen was opened under cyclopropane anesthesia. The stomach and duodenum seemed to fill the entire abdominal cavity. The cecum lay just below the distal end of the stomach and from it a dense band of reflected peritoneum passed over the descending duodenum thus effectively compressing its lumen. After releasing the abnormal adhesions the duodenal canal refused to be dilated. Pressure on the dilated stomach did not force the fluids beyond the point of obstruction. The baby was in such a precarious state that an antecolic gastrojejunostomy seemed advisable. After opening the collapsed jejunal lumen and forcing

mineral oil along its canal the anastomosis was performed and the Levine tube inserted into the distal jejunal loop. No attempt was made to correct the malrotation. In spite of the most zealous postoperative therapy this emaciated youngster died on the fourth postoperative day from a bronchopneumonia.

Autopsy studies demonstrated a functioning stoma and a complete occlusion of the duodenal wall at the point where the adhesions had been divided. An early diagnosis with prompt surgical correction might have saved this baby.

CASE III. *Congenital Atresia of Duodenum:* J. C., a female, full term, weighed five pounds and ten ounces at birth. The obstetrician noticed that the epigastrium was greatly distended and the skin had deep icteric tinge. A pernicious and persistent vomiting followed the first feeding. The acholic vomitus consisted· of gastric juices and milk curds. No meconium was passed even though given small colonic flushing and the returning fluids were acholic. In spite of daily transfusions of 30 cc. of whole blood a progressive anemia developed.

The attending physician made the presumptive diagnosis of icterus neonatorum.

The baby was six days old when first seen in consultation. The weight was four pounds ten ounces. The icteric index was 85, the urine contained 4 plus bile but lavage of both the stomach and bowel were negative for bile pigments. Scout films revealed a dilation of the stomach and duodenum while the ileum was not visualized, but the colon contained a few pockets of gas. (Fig. 3.) *The colonic gas was thought to have been introduced when giving the enema. A diagnosis of complete atresia of the duodenum with obstruction of the bile ducts was made, but as the baby was moribund operative intervention was deferred. She died two hours later.*

Autopsy findings demonstrated the duodenum to consist of a solid cord, having no lumen. The gallbladder and bile ducts were enormously dilated as the atresia had effectively obstructed the ampulla of Vater. The enlarged liver was deeply stained with bile pigments resembling an adult type of biliary cirrhosis.

In spite of these extensive malformations such conditions are amenable to surgery. Had an early diagnosis been made and the proper preoperative treatment

administered the defects could have been remedied by doing a gastrojejunostomy and cholecystoenterostomy. It is interest-

FIG. 4. Case IV. The ingested barium fills the dilated stomach and duodenum but fails to pass into the jejunum. The absence of gas in all segments of the lower intestinal tract suggests the presence of a congenital obstruction of the duodenum.

ing how well the fetus tolerates these congenital deformities and it is not until birth that toxic symptoms develop. Hicken and Crellin[2] reported five cases of congenital atresia of the bile ducts and outlined remedial procedures. It is imperative that the provocative cause of the jaundice be accurately determined if these patients are to be saved.

CASE IV. *Transverse Septal Diaphragm of the Duodenum:* B. M., a female, weighing six pounds four ounces, appeared normal at birth. On the second day a peculiar cyanosis appeared which was readily relieved by oxygen therapy, but no pulmonary or cardiac abnormalities could be demonstrated. There was a spontaneous evacuation of bile stained meco-

nium. A persistent and troublesome vomiting contributed to a rapid dehydration and emaciation. A barium meal revealed a complete

FIG. 5. Case IV. A progress film taken on the third postoperative day shows the barium escaping through the stoma into the upper jejunum. The entire intestinal tract is now patent as attested by the presence of gas in various segments of the intestinal tract.

obstruction of the first part of the duodenum as none of the barium was seen to pass into the jejunum. (Fig. 4.) The small intestines and colon were devoid of gas bubbles. The extremities were slightly spastic. A presumptive diagnosis of a complete atresia of the supra-ampullary portion of the duodenum and cerebral birth injuries seemed reasonable.

Dr. Scott Smith administered cyclopropane anesthesia supplemented by the intravenous injection of intocostrin (curare-Squibb). The stomach, duodenum, and gallbladder were enmeshed in a dense mass of adhesions, which were thought to have been produced by a neonatal pericholecystitis. After liberating these structures a heavy strand of adhesions was seen to cross the transverse duodenum.

This cicatricial band was divided and attempts were made manually to force the gastric contents along the duodenum, but an impassable obstruction was encountered just above the ampulla of Vater. The anterior *surface of the stomach was opened and a small catheter was passed into the duodenum but the persisting obstruction was again encountered.* As the patient's condition was precarious an anterior gastrojejunostomy was performed and a Levine tube was threaded through the newly formed stoma so that it lay in the distal loop of the jejunum.

During the first three days the postoperative course was very pleasing as all jejunal feedings were retained. (Fig. 5.) The following morning she developed a fulminating hyperthermia, an untractable cyanosis, and a progressive pulmonary congestion which terminated fatally six hours later. An autopsy revealed a bilateral apoplexy of extensive proportions, small petechial hemorrhages through the brain, diffuse pneumonitis and a localized peritonitis. Apparently the intracranial hemorrhages accounted for the preoperative cyanosis and the hemorrhagic changes of the adrenal glands produced the hyperthermia. It seems reasonable to assume that these complications resulted from birth injuries. The gastrojejunostomy stoma was functioning, for stomach contents were found in the ileum. (Fig. 5.) There was slight leakage at the stoma for small amounts of the gastric juices had seeped out between the sutures. Interestingly, both the abdominal wound and the gastric stoma presented no evidence of healing.

CASE V. *Complete Atresia of Duodenum and Bile Ducts:* L. C., a female, had suffered from a pernicious vomiting during the first three days of life. Biluria, acholic stools, intense jaundice, malnutrition, melena and enlargement of the liver suggested *the diagnosis of atresia of the duodenum and bile duct. In spite of an energetic attempt to prepare her for operation she died the following day.* Postmortem studies demonstrated a complete atresia of the gallbladder, bile ducts and duodenum. Such extensive abnormalities cannot be corrected.[2]

COMMENTS

Acute obstructions of the duodenum in the newborn must be classed as surgical emergencies. Delay merely invites a prohibitive mortality as indicated in this study. In our series of five cases there was an overall mortality of 80 per cent. One patient was moribund when surgical consultation was obtained so no operation was attempted. Two babies had remedial conditions but were so desperately ill that they were unable to withstand the operative shock. One infant had such an extensive atresia of the biliary radicals that correction was impossible. Only one infant made a complete recovery. In retrospect, however, we sincerely believe that an early diagnosis combined with corrective surgery might have saved four of these five patients. Three unnecessary deaths seem to be a high price to pay for procrastination.

Case	Anatomy	Operation	Result
S. S. Female	Compressive adhesions transverse duodenum Atresia duodenum	Anterior gastrojejunostomy	Recovery—well 1 year
B. J. Female	Atresia transverse duodenum Faulty rotation of cecum	Anterior gastrojejunostomy	Died—pneumonia 4th postoperative day
J. C. Female	Atresia duodenum at ampulla Vater	No operation; moribund when seen	Confirmed by autopsy
B. M. Female	Transverse duodenal diaphragm, supra-ampullary	Anterior gastrojejunostomy	Adrenal apoplexy; died 5th postoperative day; cerebral hemorrhage
L. C. Female	Complete atresia of duodenum and bile ducts	Exploration only	Died 5th postoperative day

This study emphasizes one other important fact, namely, that the surgeon cannot assume that the cicatricial bands which are compressing the duodenum are solely responsible for the obstruction. Occasionally, as in two of our patients, there may be an associated segmental atresia of the duodenal lumen. Unless both conditions are corrected the obstructive syndrome continues.

SUMMARY

1. Five cases of acute obstruction of the duodenum occurring in the newborn are presented.

2. A discussion of the various anatomic abnormalities encountered, symptomatology, roentgenograph diagnosis and methods of treatment are presented.

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Announcement: The American Association for the Study of Goiter announce that their annual meeting will be held at the Drake Hotel, Chicago, Illinois, June 20, 21, 22, 1946. This will be the first meeting held since the beginning of the War.

NON-ECLAMPTIC LATE TOXEMIAS TREATED BY VITAMIN E

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FOR several years past[1,2] a study has been made of the effect of administering vitamin E to women suffering from the non-eclamptic late toxemias of pregnancy.

What follows is an analysis of 128 consecutive, unselected "toxemias" of this type seen in private practice and so treated with vitamin E. Many of these patients had salt restriction as well, but no other therapy was used, and all were ambulant throughout, except Case 94. Many of them came under care in the first trimester of pregnancy, as will appear. Large doses of vitamin E were often required, especially toward term.

The late toxemias were regarded for the purpose of this study as the state of those patients displaying edema and/or hypertension and/or albuminuria in the latter half of pregnancy. These toxemias were held to be non-eclamptic if the blood estrogen level was high or "positive."[3]

The writer has repeatedly demonstrated,[4,5] as have others,[6] that a low estrogen value is a fundamental feature of either true pre-eclampsia or convulsive eclampsia. Indeed, clinical differentiation between the late toxemias is generally impossible without blood estrogen assays.

Such differentiation is essential if vitamin E is to be used therapeutically for pregnancy toxemias, for E probably is harmful to pre-eclamptics.[5] Surely endocrine therapy should always be preceded by endocrine diagnosis, and vitamin E is a powerful anti-estrogen.[7]

It is obvious that the designation of advanced pregnancies as toxemic when presenting any or all of the triad of albuminuria, edema or hypertension leaves much to be desired. Those who favor the nomenclature of the American Committee on Maternal Welfare must look at it askance. But this ancient classification is simple, certainly includes all the cases which should be considered, and is the one generally used by practitioners and most specialists. Of course it includes, unfortunately for scientific accuracy, all those patients having renal-vascular damage long antecedent to pregnancy. But these last could not react very favorably to any therapeutic measure used only during a pregnancy; therefore, the clinical results that were achieved should not be biased in its favor. Our scales have thus been weighted against E deliberately.

DATA AND ITS ANALYSIS

The clinical data on the 128 women are listed in Table I. The blood pressures of the 128 women are as set forth in Table II.

Most of these women came under observation in the first trimester of pregnancy, as a glance at Table I will show. However, a large percentage, 79 per cent to be exact, did not attain a systolic of more than 160 or a diastolic of more than 100 during what remained of their pregnancies. Moreover, at the time of delivery, fully 43 per cent of the women with elevated pressures had pressures appreciably lower than the highest they had exhibited during gestation.

It is to be remembered that only one of these women was put to bed. The remainder did their housework as usual.

The beneficial effect of E therapy is demonstrated even better by observations made on their edema. Thirty-eight per cent of the women had no edema at delivery, 30 per cent had only slight edema, and but 32 per cent revealed more than that.

The figures on albuminuria are also of

TABLE I

Case	Under My Care (in Weeks)	When First Seen (in Weeks)	First Sign of Toxaemia and When (in Weeks)	Highest Blood Pressure and When (in Weeks)	Blood Pressure at Time of Delivery	Oedema at Delivery	Albumin at Delivery	Stage at Delivery (Wks.)	Manner of Labour and Delivery	Child	Later Course	Remarks
1	18	22	Hypertension @ 32	174/116 @ 38	140/98	0	tr.	40	Spont.	One forearm absent. 7½ lb. boy.	?	
2	20	20	Hypertension before seen.	198/104 @ 28	188/102	+	0	40	Spont.	Stillborn 14½ lb. male. Erythroblastosis.	196/112 2 yrs. later.	
3	28	12	Oedema @ 37	134/76 @ 38	126/76	+	0	40	Spont.	8′5″ boy.	Normal 2 yrs. later. Sterilized.	
4	30	10	Hypertension and oedema before seen.	150/100 @ 37	138/88	0	0	39	C. S.	7′8″ girl.	170/120 3 yrs. later.	
5	35	5	Hypertension before seen.	166/98	154/94	++	0	39	Med. ind.	8′5″ boy	9 wks. later 156/98.	
6	34	6	Oedema @ 25	142/94 @ 40	142/84	+++	0	40	Spont.	8′4″ girl.	Slight oedema 3 yrs. later.	
7	18	22	Hypertension @ 36	146/86 @ 39	108/76	0	0	40	Spont.	8′5″ boy.		
8	31	9	Oedema @ 33	132/80 @ 34	128/70	+++	0	40	Spont.	7′9″ girl.	Normal for 2 yrs.	
9	32	8	Oedema @ 37	138/94 @ 38	134/84	++	0	40	Spont.	7′4″ boy— idiot.	Normal 5 yrs. later.	
10	28	12	Hypertension @ 32	144/96 @ 37	134/94	+	0	39	Med. ind.	8′8″ boy.	Normal 3 yrs. later.	
11	19	21	Hypertension before seen.	238/138 @ 38	170/92	0	3+	38	C. S.	8′14″ girl	Diabetis 5 yrs. later.	Diabetes
12	35	5	Hypertension @ 11	160/96 @ 11	136/96	0	0	40	Spont.	7′ girl		
13	18	22	Albumin @ 31	140/100 @ 37	136/100	0	0	40	Spont.	7′8″ boy.	Normal 14 mos. later.	
14	36	4	Hypertension @ 37	144/104 @ 39	144/104	+	0	40	Spont.	7′ girl		
15	26	14	Hypertension @ 32	140/94 32	132/82	+	0	40	Spont.	7′ girl		
16	32	8	Hypertension before seen.	164/80 @ 30	150/70	0	0	40	Spont.	7′14″ boy.		
17	24	16	Hypertension @ 30	164/88 @ 38	148/76	0	0	40	Spont.	6′6″ girl		
18	36	4	Oedema @ 36	138/98 @ 40	116/56	3+	0	40	Spont.	8′ boy		
19	35	5	Oedema & albumin @ 27	154/104 @ 40	154/104	+	0	40	Spont.	8′2″ girl	Normal 5 yrs. later.	
20	20	20	Hypertension @ 30	146/94 @ 40	144/90	0	0	40	Spont.	8′ boy	Normal 1 yr. later	
21	31	9	Oedema @ 26	150/82 @ 42	150/80	+	0	42	Med. ind.	9′ boy	Glaucoma 6 yrs. later.	
22	18	22	Albumin & hypertension @ 30	146/116 @ 35	140/116	0	4+	33	Spont.	Stillborn breech	?	Pyelitis after 30th wk. Bleeding daily from 25-29 wks. Praevia suspected but excluded.
23	34	6	Hypertension @ 17	140/94 @ 36	140/94	+	0	36	Spont.	6′ girl	....	
24	34	6	Hypertension @ 27	194/104 @ 40	194/104	0	?	40	Med. ind.	6′9″ girl		Off vit. E for 3 dys. before delivery. B.P. jumped then from 136/94 to 194/104 in last 12 dys.

TABLE I (Continued)

Case	Under My Care (in Weeks)	When First Seen (in Weeks)	First Sign of Toxaemia and When (in Weeks)	Highest Blood Pressure and When (in Weeks)	Blood Pressure at Time of Delivery	Oedema at Delivery	Albumin at Delivery	Stage at Delivery (Wks.)	Manner of Labour and Delivery	Child	Later Course	Remarks
25	18	22	Hypertension @ 29	148/104 @ 38	134/100	o	o	41	Spont.	7'7" girl	....	Temporary amblyopia in last 3 wks. B.P. 144/92 four mos. p.p.
26	13	17	Hypertension @ 30	142/94 @ 35	140/94	+	o	39	Spont.	6'2" girl	....	Appendectomy for abruptio placentae (!) @ 3 mos. Pain remained until controlled by F. Idiosyncrasy to r. developed later.
27	20	20	Oedema @ 27	150/88 @ 38	124/84	4+	o	40	Med. ind.	8'2" girl	....	Hydatid mole 8 mos. later.
28	15	25	Hypertension @ 36	144/104 @ 38	120/88	+	o	41	Spont.	7'4" boy		
29	13	17	Hypertension @ 18	152/104 @ 37	142/84	o	o	40	Spont.	8'1" girl		
30	12	18	Oedema @ 20	132/94 @ 34	132/94	2+	o	37	Med. ind.	7'4" girl		
31	20	20	Hypertension @ 28	162/118 @ 34	164/116	2+	o	34	Med. ind.	Craniospinorachischisis.	140/96wk. after delivery.	
32	26	14	Oedema @ 38	134/98 @ 40	134/98	4+	o	40	Med. ind.	8'14" girl		
33	15	25	Oedema @ 36	146/100 @ 36	144/94	2+	o	36	Spont.	6' boy		
34	31	9	Hypertension @ 22	150/54 @ 30	132/70	4+	o	39	Spont.	7'6" girl		
35	16	24	Hypertension before seen.	146/94 @ 36	140/80	o	o	38	Spont.	7'12" girl		
36	29	11	Hypertension @ 34	134/96 @ 39	134/96	o	o	40	Spont.	8' girl		
37	28	12	Hypertension @ 16	154/94 @ 41	154/94	3+	o	41	Med. ind.	7'9" boy		
38	25	15	Hypertension @ 18	150/88 @ 37	128/82	2+	o	40	Spont.	9'8" boy	1½ yrs. later B.P. 144/88	
39	26	14	Oedema @ 31	118/84 @ 37	114/76	3+	o	38	Spont.	8' boy		
40	24	12	Hypertension before seen.	152/84 @ 21	116/76	+	o	36	Spont.	9'13" boy		
41	28	2	Hypertension before seen	154/96 @ 17	110/82	o	o	30	Spont.	anencephalic with clubfeet.	5 mos. later B.P. 138/70	
42	24	14	Oedema @ 21	140/100 @ 38	140/100	o	o	38	Med. ind.	8'1" boy	9 mos. later 120/70	
43	12	28	Oedema @ 36	110/72 @ 40	110/72	2+	o	40	Spont.	6'1" girl		
44	26	12	Oedema @ 31	136/90 @ 38	136/90	3+	o	38	Spont.	7' boy		
45	24	16	Hypertension @ 25	140/120 @ 28	128/86	o	o	40	Spont.	7' boy		
46	29	11	Oedema @ 23	134/84 @ 40	134/84	3+	o	40	Med. ind.	7'2" girl		
47	25	15	Hypertension before seen	164/100 @ 40	164/100	2+	+	40	C. S.	6' girl		Mother was an achondroplasic dwarf.
48	26	14	Hypertension @ 28	148/106 @ 39	140/100	o	o	40	Med. ind.	7'10" girl	7 wks. later B.P 130/0	
49	26	12	Hypertension & oedema @ 30	150/102 @ 38	150/102	o	o	38	Med. ind.	6' girl	6 wks. later B.P. 136/88	
50	14	26	Hypertension when seen.	140/96 @ 38	136/100	o	2+	40	Spont.	7'8" boy	14 mos. later B.P. 118/76	

TABLE I (*Continued*)

Case	Under My Care (in Weeks)	When First Seen (in Weeks)	First Sign of Toxaemia and When (in Weeks)	Highest Blood Pressure and When (in Weeks)	Blood Pressure at Time of Delivery	Oedema at Delivery	Albumin at Delivery	Stage at Delivery (Wks.)	Manner of Labour and Delivery	Child	Later Course	Remarks
51	10	26	Hypertension when seen.	156/100 @ 34	156/100	o	o	36	Spont.	mac. term girl	?	
52	30	4	Hypertension @ 9 wks.	154/106 @ 33	150/104	+	4+	34	Spont.	mac. boy	6 wks. later B.P. 140/80	
53	33	9	Oedema @ 21	120/74 @ 40	110/80	3+	o	42	Spont.	7'14" boy	9 mos. later sl. oedema.	
54	34	6	Oedema @ 34	148/88 @ 39	148/88	+	o	40	Spont.	6'14" boy	?	
55	26	14	Hypertension before seen.	144/90 @ 38	122/80	o	o	40	Spont.	8'4" girl	B.P. 8 mos. later 142/102	
56	35	3	Hypertension @ 32	148/106 @ 36	138/110	o	o	38	Med. ind.	6'14" girl	11 mos. later B.P. 140/84	Much pyelitis in pregnancy.
57	29	9	Hypertension @ 31	140/90 @ 34	130/80	o	o	38	Spont.	6'3" girl	1 yr. later B.P. 124/74	
58	35	6	Hypertension @ 32	142/90 @ 35	142/86	2+	o	41	Med. ind.	8'4" boy	?	
59	10	28	Oedema @ 25	1-8/114 @ 3-	156/108	+	o	38	Spont.	9'3" boy	3 mos. later B.P. 136/90	
60	35	5	Oedema @ 26	130/80 @ 38	130/76	4+	o	40	Spont.	9'2" boy	?	
61	25	14	Hypertension for years.	146/104 @ 3-	148/100	2+	o	39	Med. ind.	6'7" girl	11 mos. later B.P. 176/114	
62	39	5	Hypertenson @ 11	164/102 @ 42	140/102	+	o	44	Spont.	6'12" girl	4 mos. later B.P. 130/108	
63	27	14	Hypertension @ 18	140/~4 @ 26	134/86	o	o	41	Med. ind.	9' boy	?	
64	9	31	Hypertension before seen	154/92 @ 39	132/96	+	o	40	Spont.	big boy	?	
65	35	4	Hypertension @ 15	138/106 @ 36	140/98	3+	tr.	39	Med. ind.	9'3" girl	11 wks. later B.P. 120/90	
66	3	40	Hypertension before seen.	150/110 @ 40	152/94	+	o	43	Spont.	7'1" boy	11 mos. later B.P. 108/80	
67	3	38	Oedema before seen.	154/96 @ 40	154/96	3+	o	41	Spont.	9' boy	?	
68	27	12	Hypertension before seen.	140/90 @ 34	128/88	+	o	39	Spont.	8'8" girl	?	
69	21	21	Hypertension @ 23	146/94 @ 40	148/90	4+	o	42	Spont.	6'5" boy	7 mos. later B.P. 130/86	
70	18	22	Oedema @ 28	146/92 @ 36	138/84	2+	o	40	Spont.	6' boy stillborn.	8 wks. later B.P. 104/80	
71	22	16	Hypertension when seen.	156/98 @ 28	140/92	o	o	38	Spont.	7'3" boy	?	
72	16	22	Hypertension when seen.	148/106 @ 36	148/106	o	o	38	C. S.	8'9" boy	?	
73	34	8	Oedema @ 22	144/96 @ 41	120/94	4+	+	42	Spont.	8'5" boy	10 wks. later B.P. 112/78	
74	31	10	Oedema @ 27	112/80 @ 40	112/80	+	o	41	Spont.	6'2" girl	?	
75	19	22	Hypertension @ 26	150/88 @ 29	128/78	o	o	41	Spont	9'2" girl	?	
76	34	8	Hypertension @ 28	160/88 @ 18	128/88	o	o	42	Spont.	6'3" girl	1 yr. later B.P. 130/84	
77	27	8	Hypertension before seen.	138/96 @ 35	138/96	o	o	35	Spont.	6'5" boy		

TABLE I (Continued)

Case	Under My Care (in Weeks)	When First Seen (in Weeks)	First Sign of Toxemia and When (in Weeks)	Highest Blood Pressure and When (in Weeks)	Blood Pressure at Time of Delivery	Oedema at Delivery	Albumin at Delivery	Stage at Delivery (Wks)	Manner of Labour and Delivery	Child	Later Course	Remarks
78	25	15	Hypertension before seen	148/96 @ 20	144/84	tr	0	40	Spont	8'11" girl		
79	12	26	Oedema @ 33	130/88 @ 37	130/88	3+	0	38	Spont	7'2" boy		
80	36	4	Hypertension & oedema @ 32	132/100 @ 39	132/100	0	0	40	Spont	7'6" girl	3 yrs later B P 106/66	Sterile since
81	24	14	Hypertension before seen	190/124 @ 38	190/124	+	ft tr	38	Med ind	6'12" girl	6 mos later B P 140/90	
82	31	10	Oedema @ 16	140/86 @ 39	140/86	0	0	41	Med ind	9'2" girl		
83	37	2	Hypertension @ 37	138/96 @ 38	110/68	+	0	39	Spont	7' girl		
84	16	25	Hypertension & oedema @ 27	144/94 @ 38	110/76	+	0	41	Spont	7'8" girl		
85	25	14	Hypertension @ 26	154/90 @ 36	142/92	0	0	39	Spont	8' boy		
86	20	24	Oedema @ 33	140/84 @ 42	136/76	0	0	44	Spont	6'14" boy		
87	30	10	Hypertension @ 14	148/94 @ 40	148/94	0	0	40	Spont	6'14" boy		
88	29	10	Oedema @ 19	128/94 @ 33	126/84	4+	0	39	C S	4'6" girl	116/80 @ 6 wks	Abruptio placentae Child lived for 5 wks then died of pneumonia
89	30	12	Oedema @ 28	156/88 @ 39	140/90	0	0	42	Spont	5'8" boy	13 mos later B P 120/80	
90	33	7	Hypertension @ 26	160/102 @ 40	160/102	+	0	40	Med ind	7'9" boy		Has kraurosis vulvae at age of 33'
91	24	8	Hypertension @ 23	158/116 @ 31	158/116	+	0	32	Med ind	7 mos anencephalic with sp bifida	136/90 @ 6 wks	
92	17	22	Hypertension @ 23	144/88 @ 28	144/80	0	0	39	Spont	7'9" girl		Much pyelitis in pregnancy
93	37	3	Hypertension before seen	136/100 @ 36	126/90	0	3+	40	Spont	6'6" boy	12 mos later B P 116/80	Enormous ovarian cyst removed at 2 mos Twins lived
94	25	10	Hypertension before seen	212/130 @ 32	190/110	3+	4+	35	bag ind	twin girls 3'7" 2'4"	3 mos later B P 164/106	
95	35	3	Hypertension @ 7	144/94 @ 34	148/76	0	0	38	Spont	7'1" girl	4 mos later B P 118/-8	
96	14	26	Hypertension @ 30	150/94 @ 40	150/94	+	0	40	Med ind	9'6" boy	7 wks later B P 124/88	
97	16	26	Hypertension before seen	156/100 @ 30	144/96	+	0	42	Spont	8'1" boy	4 mos later B P 164/108	Primary inertia Duhrssen's incisions
98	35	7	Hypertension before seen	150/98 @ 41	126/86	4+	0	42	Med ind	8'13" boy		Maximal pyelitis—could not control it Abruptio finally
99	24	6	Oedema @ 20	140/76 @ 22	120/70	0	0	30	Spont	3' boy— lived 4 hrs	Still sl pyuria 4 mos after	
100	32	8	Oedema @ 23	136/80 @ 40	136/80	3+	0	40	Spont	8'7" boy		
101	26	16	Hypertension @ 32	164/104 @ 42	164/104	0	0	42	Med ind	mac male	9 wks later B P 156/90	Pyelitis in this pregnancy Severe pre-eclampsia in labour
102	26	8	Oedema @ 22	140/88 @ 28	118/76	4+	0	34	Spont	6'7" boy		

TABLE I (Continued)

Case	Under My Care (in Weeks)	When First Seen (in Weeks)	First Sign of Toxaemia and When (in Weeks)	Highest Blood Pressure and When (in Weeks)	Blood Pressure at Time of Delivery	Oedema at Delivery	Albumin at Delivery	Stage at Delivery (Wks.)	Manner of Labour and Delivery	Child	Later Course	Remarks
103	29	10	Oedema @ 26	136/86 @ 38	136/86	3+	o	39	Spont.	7'7" girl		
104	37	3	Hypertension @ 12	170/88 @ 39	170/88	o	+	40	Spont.	7'2" boy	2 mos. later B.P. 170/74	
105	23	16	Hypertension @ 18	160/100 @ 38	140/84	+	o	39	Spont.	7'7" girl		
106	36	4	Oedema @ 23	134/96 @ 37	118/86	2+	o	40	Spont.	8'2" boy		
107	4	37	Oedema before seen.	152/76 @ 40	152/76	2+	o	41	Spont.	9'3" girl		
108	20	20	Oedema @ 25	136/88 @ 37	128/76	4+	o	40	Spont.	8'9" girl		
109	31	9	Oedema @ 26	128/86 @ 37	122/76	2+	o	40	Spont.	4'10" girl		
110	28	12	Oedema @ 26	110/90 @ 38	120/80	+	o	40	Spont.	7'4" boy	....	Pyelitis.
111	34	6	Oedema @ 21	140/86 @ 38	126/84	3+	o	40	Spont.	8'10" boy	11 wks. later B.P. 118/76	Cholecystitis after delivery.
112	35	6	Hypertension @ 12.	154/88 @ 41	128/88	+	o	41	Med. ind.	7'15" boy		
113	19	22	Hypertension @ 37.	130/92 @ 40	130/76	+	o	41	Med. ind.	8'7" boy		
114	27	12	Hypertension @ 28.	144/86 @ 30	132/74	2+	o	39	Spont.	8'8" boy		
115	11	26	Hypertension when seen.	170/90 @ 33	144/88	o	o	37	Spont.	6'7" boy		
116	32	8	Hypertension @ 20.	144/88 @ 34	150/84	o	o	40	Spont.	6'12" boy		
117	33	7	Oedema @ 32.	130/90 @ 38	130/90	+	o	40	Spont.	7'7" boy		
118	34	4	Hypertension before seen.	156/94 @ 7	130/96	+	ft. tr.	38	Spont.	7'11" boy	6 wks. later B.P. 140/82	
119	35	4	Oedema @ 28.	124/90 @ 38	124/90	3+	ft. tr.	39	Spont.	7'2" boy stillborn	5 wks. later B.P. 130/90	Prolapsed hand, version, contraction ring, craniotomy.
120	35	3	Oedema @ 24.	130/86 @ 36	130/86	2+	o	38	Spont.	8'8" boy		
121	21	18	Hypertension @ 22	140/86 @ 25	136/80	+	o	39	Spont.	6'5" girl	....	Huge woman.
122	28	12	Hypertension @ 18	150/76 @ 34	136/86	+	o	40	Med. ind.	6'10" girl	11 wks. later B.P. 134/76	Pulmonary embolism, but survived.
123	2	36	Hypertension before seen.	136/90 @ 36	114/80	+	o	38	Spont.	child (boy) died in labour.		
124	26	14	Hypertension oedema @34	118/94 @ 37	118/94	+	o	39	Spont.	7'15" boy		
125	36	3	Hypertension @ 31	130/90 @ 33	136/84	o	o	39	Spont.	7'8" girl	....	Pyelitis in pregnancy.
126	33	6	Hypertension @ 10	130/90 @ 34	130/84	o	o	40	Spont.	8'12" girl		
127	10	30	Hypertension @ 28	140/88 @ 40	140/88	o	o	40	Spont.	8'6" girl	6 wks. later B.P. 124/66	
128	26	12	Oedema @ 23	164/108 @ 38	164/108	+	tr.	38	Med. ind.	5'10" boy	later 6 mos. was 114/84	

Key to Abbreviations in Tables

Spont. = spontaneous delivery.
Med. ind. = castor oil, quinine and artificial rupture of membranes.
Mac. = macerated.
Wks. = weeks.
C. S. = Caesarean.
vit. = vitamin.
mos. = months.
yrs. = years.
ft. tr. = faint trace.

interest. Fully 88 per cent had no albuminuria at delivery and only 6 per cent revealed a "one plus" or more.

TABLE II

Highest B.P. attained in pregnancy	250+ 130+	200–249 115–129	160–199 100–114	140–159 90–99	139 or less 89 or less
No. of cases	1	3	24	78	22

But the most striking effect of this management is to be seen on inspecting the duration which the gestations attained and the final weight of the babies then delivered. It is only too well known how many such toxemic pregnancies, as usually managed, end in premature delivery whether artificially induced or occurring naturally, stillbirth, in abruptio placentae or in the delivery of puny "immature" infants. Such terminations are not common in this series. Excluding Cases 2, 31, 41 and 91 which ended in the induced or natural delivery of monsters, Cases 51, 52, 101 ending in miscarriages or the expulsion of macerated fetuses, and Case 94, which ended in the bag induction of twins (which survived), fully 92 per cent of these 120 pregnancies ended at term, as judged by both birth weight and known duration of gestation. Only 4 per cent of these were induced or sectioned before term. (Only one of these was sectioned—Case 88). There were only 3 per cent prematures, induced or not. There were only seven stillbirths, excluding just the gross monsters. There was only one case of classical abruptio placentae. The average birth weight, excluding the twins, miscarriages, stillbirth, and monsters, was 7 pounds 11 ounces for the boys, and 7 pounds 6 ounces for the girls.

Owing to its cost, vitamin E therapy was continued in every case only until delivery. Whether it should have been stopped then is doubtful, for some of these patients had higher or at least as high blood pressures weeks and months postpartum. This was true, too, of many who had been quite normal in the early months of their gestations, and could not have been regarded as "essential hypertensions" or "nephritic" cases.

COMMENTS

In 1937, the author[8] presented evidence to show that only about 10 per cent of the late toxemias were truly pre-eclamptic or eclamptic, having "negative" estrogen values. All the remainder could be conveniently lumped together for therapeutic purposes as belonging to the non-convulsive or high estrogen type. The toxic women presented in this series constitute the major part of all the toxic patients seen by the writer in a ten-year period. Six more patients of this type could not be included in the statistics because of scanty data. Only twenty-one women having true pre-eclampsia and three convulsive eclamptics were seen in the author's own practice (exclusive of consultations) during the same period of time. In other words, only 15 per cent of the total 158 toxemic women were really pre-eclamptic or eclamptic, which approximates our figure of eight years ago and the 9 per cent mentioned by Eastman and Whitridge.[9] Nothing in obstetrics has been either more ludicrous or more misleading than the idea that the majority of the late toxemias would progress to convulsions unless treated properly. It is not good therapy that saves 85 per cent of such women from fits, but the fact that they could not possibly have fits under ordinary circumstances. It should be noted, however, that if these women are given very large doses of vitamin E in the last day or so before labor begins when, as immediately after parturition, there appears to be a sudden, sharp fall of the blood estrogen level, convulsive eclampsia may sometimes be precipitated.[4,10] For this reason, the author now gives such women large doses of estrogens during delivery, hoping to ward off postpartum convulsions at least.

It is important to begin vitamin E therapy at least as soon as any evidences of toxemia appear. It is very much less effective if hypertension or edema becomes well established. As all of these women had blood estrogen assays when first seen, the abortion-toxemia-miscarriage taint,[11,12] was detected in nearly all, even before clinical signs developed.

It is obvious that vitamin E is not the last word in the management of these non-convulsive toxemias, but it is equally clear from this study that it should become a major item in their therapy.

If pregnancy can be regarded as a nine-months' long experiment on renal-vascular function or even on renal-vascular histopathology, the implications of this work are interesting.[1] Is there not a suggestion here of a new approach to the study of acute nephritis and nephrosis, as well as hypertension, to name the most obvious?

Finally, mention may be made of a suggestive finding in relation to the hypertensions of this non-eclamptic group of toxemic pregnancies. Several years ago the late Dr. Percy Johns, one of our pathologists, and the writer studied a series of umbilical cords obtained from fetuses aborted, miscarried, or delivered prematurely or at term. Those obtained from mothers having high blood estrogen values in pregnancy showed a notable deficiency of the elastic laminae in the blood vessel walls. These laminae were fragmented and greatly attentuated. They gave the appearance of being pulled apart, fiber from fiber. This picture often appeared early in pregnancy. It is probable that such umbilical cord vessels would convey a sluggish blood stream to the fetus unless the vis a tergo were considerably raised. May not this offer an explanation of the hypertensions of some of the group of women under consideration? Their blood pressures would need to be raised early and to considerable heights in order to nourish their fetuses properly. No form of therapy could hope to lower that blood pressure appreciably and yet pre-serve those fetuses. This may explain why the vitamin E used in our study has been most effective in maintaining fetal weight, and preventing maternal edema and albuminuria, and least effective in reducing maternal hypertension.

There may be some linkage between this observation on the defective structure of the umbilical vessel walls in high estrogen, low E human pregnancies, and Mason's[13] histological studies of the fetal vessels in low-E rat pregnancies. He concluded: "some still unexplained functional or structural weakness in the vascular wall, leading to dilation and stasis, is the characteristic lesion" (of E-deficiency in the fetal rat).

SUMMARY

The histories of 128 consecutive, unselected women having a late toxemia of pregnancy of the non-convulsive type are analyzed.

2. These women were usually seen for the first time in the first half of their pregnancies.

3. All but one were ambulant throughout, and engaged in their usual tasks.

4. All had "positive" blood estrogen values and were treated with vitamin E only, with or without salt restriction.

5. Seventy-nine per cent never attained a blood pressure above 160/100. At delivery 43 per cent had lower pressures than the highest attained during pregnancy.

6. Thirty-eight per cent had no edema at delivery and 30 per cent had only slight edema.

7. Eighty-eight per cent had no albuminuria at delivery and only 6 per cent had a "one plus" or more.

8. About 92 per cent of these pregnancies ended at term (this is a corrected figure). Only 4 per cent were induced or sectioned before term. There were 6 per cent stillbirths, excluding only the gross monsters.

9. The birth weight of the living boys was 7 pounds 11 ounces and of the living girls 7 pounds 4 ounces (a corrected figure).

10. This type of toxemia constitutes *85 per cent of the toxemias seen by the* writer.

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ECLAMPTIC convulsions are typical in their characteristics and coma is fairly deep between the convulsive seizures. There is a general aggravation of the other symptoms of preeclampsia including increased blood pressure, edema, and renal and hepatic changes.

From "The Management of Obstetric Difficulties" by Paul Titus (C. V. Mosby Company).

PRIMARY MALIGNANT TUMORS OF THE SPLEEN

WITH SPECIAL REFERENCE TO ENDOTHELIOMAS

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NEW YORK, NEW YORK

PRIMARY malignant tumors of the spleen are infrequent. In 4,000 operations at the Boston City Hospital, for example, splenectomy was twice resorted to for primary malignant tumor of that organ. Theile reported four examples of angiomas of the spleen which were found in 1,900 necropsies over a period of four and a half years in the laboratory of Prof. Lubarsch. Of these only one showed evidence of malignancy.

Smith and Rusk, in 1923, summarized reports of 102 primary malignant tumors after a careful review of the literature, and added two of their own, which they designated endotheliomas.

Hausmann and Gaarde (1943) carefully studied the literature subsequent to 1923, and were able to collect forty-four additional malignant tumors of the spleen, which included nine of lymphosarcoma. Twenty additional reports were indexed from those which were not available to the authors. To this group they added nine reports collected from the records of the Mayo Clinic, thus bringing the total to 178, of which thirty-three were lymphosarcomas.

CLASSIFICATION OF SPLENIC TUMORS

In classifying splenic tumors, Smith and Rusk, as well as Hausmann and Gaarde, divided them into the following five groups:

A. *Tumors arising from splenic capsule and trabeculae:* (1) Fibroma; (2) fibrosarcoma; (3) spindle cell sarcoma. B. *Tumors arising from splenic lymphoid elements:* (1) Lymphoma; (2) lymphoblastoma: (a) lymphosarcoma, 1' large round cell (reticular-cell variety), 2' small round cell (lymphoblastic variety), 3' giant lymph follicle hyperplasia; (3) Hodgkin's granuloma. C. *Tumors arising from the endothelium of splenic sinuses:* (1) Angioma; (2) endothelioma; (3) endothelial sarcoma; (4) angiosarcoma. D. *Tumors arising from cells of the reticulo-endothelial system:* (1) Gaucher's disease; (2) Niemann-Pick splenomegalia; (3) Christian syndrome; (4) reticulo-endothelioma; (5) reticulo-endothelial sarcoma. E. *Carcinoma.*

We propose, to direct attention to group C, i.e., the group of tumors which arise from the endothelial lining of the splenic sinuses, and to report another case of angiosarcoma.

ANALYSIS OF REPORTED CASES

A. *Smith and Rusk's Tumor Data.* A careful analysis of the case histories abstracted in Smith and Rusk's paper reveals that of the 104 cases, twenty-six fall into group C. Of this number, seven were classified as endotheliomas (Smith and Rusk, (two cases); Wagner; Pasinetti; Bunting; LeFort and Legueu; Temoin and Bonnel). Marshand and Aschoff, however, termed the tumor described by Wagner a large round cell sarcoma. To this group of endotheliomas, Smith and Rusk included the cases of Stengel (designated a "neoplasm of the spleen comparable to diffuse myeloma or certain infiltrating sarcomas of the liver"); Cerkasov (perithelioma); Menetrier (splenoma); Foix and Roemmele (nodular reticulosplenoma); Arnott and O'Connor (primary (?) cancer of spleen); Friedreich, Schönstädt and Gröhe (lymphosarcoma). These authors classified the tumors reported by Golovina-Ammon (angiomatous fibrosarcoma); Cesaris (fibrosplenoma); LeFort

and Legueu (endothelioma); Villard and Santy, as examples of angiomas undergoing transition to endotheliomas.

There were two tumors called endothelial sarcoma (Weichselbaum; Risel), and three angiosarcoma (Langhans; Theile; Jores).

Smith and Rusk, in their collected series of 104 primary malignant tumors of the spleen, found twenty-one examples of lymphosarcoma, most of which were considered primary in the spleen. There were also twenty-nine tumors arising from the lymphoid elements. While a large number of these were undoubtedly lymphosarcomas, either primary or secondary, those denominated small round cell sarcomas were most likely tumors of lymphoid origin, commonly called lymphomas. On the other hand, the large round cell tumors apparently arise from reticular cells and closely resemble tumors of endothelial origin often classified as splenomas. According to Smith and Rusk, eleven of the tumors included in this group were probably of endothelial origin, and were consequently included in the category of endotheliomas. There was only one example of fibrosarcoma included in this category, namely, that reported by Jepson and Albert. Risel, however, believed that this tumor arose from the sinusoidal endothelium.

In the group of miscellaneous malignant tumors of the spleen reported and culled from the literature by Smith and Rusk, were thirteen with a varied nomenclature. Several of these tumors, when studied by other investigators, were believed to be identical with neoplasms falling into other categories, such as endotheliomas, lymphosarcomas, round cell sarcomas, et cetera.

There were also nineteen tumors described as carcinoma, but Smith and Rusk were of the opinion that most of them were actually lymphosarcomas and endotheliomas. Primary carcinoma of the spleen can arise only from an embryonic inclusion of epithelial elements, and no instance of such inclusion has even been reported. It is consequently evident that the diagnosis of carcinoma must be excluded.

B. *Hausmann and Gaarde's Tumor Data* (1923–1940). This group comprised fifty-three tumors which included nine collected from the records of the Mayo Clinic.

1. Tumors arising from splenic capsule and trabeculae:

   9 primary sarcoma
   7 large round cell sarcoma
   1 small round cell sarcoma
   2 unspecified round cell sarcoma
   3 fibrosarcoma

2. Tumors arising from lymphoid elements of spleen:

   10 lymphosarcoma
   2 reticulum cell sarcoma
   4 giant lymph follicle hyperplasia

3. Tumors arising from sinusoidal endothelium:

   2 endotheliomas (Caldwell; Biller)
   1 angioblastoma (DeNavasquez)
   1 hemangiosarcoma (DelBuono)
   4 hemangio-endothelioma (Orlandi; Zeno and Cid; Jones; Paine)
   1 malignant hemangioma (Wright)
   1 sarcoma (Krumbhaar)

4. Tumors arising from reticulo-endothelial system:

   2 reticulo-endothelioma
   2 reticulo-endothelial sarcoma

5. Primary carcinoma 1 (Werwath)

Werwath's report concerned a patient who presented a nodule on the buttock. Autopsy disclosed extensive carcinoma of the spleen and liver. For the reason previously stated, the diagnosis of primary carcinoma of the spleen must here be excluded. Hausmann and Gaarde regard this as an example of metastatic carcinoma of the spleen.

FURTHER ANALYSIS OF THE GROUP OF MALIGNANT TUMORS ARISING FROM SPLENIC SINUS ENDOTHELIUM

Combining the two series of cases in the compilations of Smith and Rusk up to 1923, and that of Hausmann and Gaarde from 1923 to 1940, there are thirty-seven in all, out of a combined total of 157

primary malignant tumors of the spleen. Of these thirty-seven tumors, sixteen (43.2 per cent) were classified as endotheliomas; four (10.8 per cent) as angiomas undergoing transition to endotheliomas; four (10.8 per cent) as endothelial sarcomas; four (10.8 per cent) as angiosarcomas; six (16.2 per cent) as hemangio-endotheliomas; one (2.7 per cent) as malignant hemangioma; one (2.7 per cent) angioblastoma; and one (2.7 per cent) sarcoma. With these data as a basis, we find that at least seventeen of the thirty-seven tumors disclosed definite angiomatous features, although it appears to us that this estimate is low.

Although Ewing maintained that endothelial sarcoma constituted the most common variety of primary malignant tumor of the spleen, a review of the literature indicates that this is not the case. We are inclined to agree with Mallory's contention that most of the reported tumors fall within the category of malignant lymphoblastomas. Although some of the tumors showed definite angiomatous features, in addition to the classical sarcomatous characteristics, the greater number, approximately 54 per cent, failed to show them, but rather disclosed cellular proliferation arising directly from the endothelial cells lining the splenic sinuses. Risel, as well as Smith and Rusk, were able to demonstrate conclusively the stages of transition from the endothelial cells of the splenic sinuses to the definitive malignant cells constituting the tumor. They found that the reticular cells played no part in the formation of this group of tumors. Ribbert, however, maintained that the recognition of a tumor of endothelial origin was solely by examination during its inception, a condition which can hardly be expected to present itself. The mere presence of endothelial cells at the margin of a growth did not, according to this observer, constitute proof that the tumor arose from the splenic sinus endothelium.

Judging from the varied terminology utilized in the identification of tumors falling within this category, and from the fact that no clear cut lines of differentiation are present, except as regards the degree of vascularity, it may perhaps be expedient to place them into two groups, namely, (1) non-vascular sarcomas arising from endothelium of splenic sinuses, and (2) malignant angiomas arising from endothelium of splenic sinuses. In this manner great confusion may possibly be avoided in recording and tabulating tumors in this category.

Sex and Age Incidence. The sex was noted in 127 patients, and of these there were seventy-three men and fifty-four women. The average age was 48.5 years.

Antecedent Diseases Involving the Spleen. A positive history of malaria was given in 13 per cent of the reported cases. Syphilis was present in 4 per cent reported by Smith and Rusk, in 4.4 per cent collected by Hausmann and Gaarde, and in 33.3 per cent observed at the Mayo Clinic. There were only four patients who furnished a history of typhoid fever.

Metastases. We have attempted to analyze the subject of metastases in the group of primary malignant tumors arising from the endothelial lining of the splenic sinus based on the report of thirty-seven tumors collected by Smith and Rusk, and Hausmann and Gaarde. There were four reports in which the data were incomplete as regard the presence or absence of metastases. In sixteen reports it was definitely stated that metastases were absent. However, closer scrutiny of this group revealed that in eleven of these patients the reports were based on surgical intervention, in four on necropsies, and in one information was not given save to the effect that metastases were absent. Of the remaining seventeen patients (48.6 per cent) who came to autopsy, the liver was involved in eleven (64.1 per cent), the lung in four (23.5 per cent), lymphnodes in five (29.4 per cent), pancreas in four (23.5 per cent), and bone in four (23.5 per cent).

Even a cursory review of the survival records reveals that the general prognosis in this disease is poor, and that in many

of the patients who apparently had no metastases at the time of operation, they were undoubtedly present at the time of

Of this number, seven (17.9 per cent) died from shock, hemorrhage or other surgical complications. This high mortality can

FIG. 1. Left pyelogram showing marked mesial displacement of kidney by tumor.

FIG 2. Barium enema showing marked displacement of splenic flexure of colon by tumor.

death. If this view is valid, it is likely that many patients had hidden metastases at the time of operation.

Symptoms. The outstanding clinical features of this group of tumors, according to Smith and Rusk, are: (1) a rapidly growing tumor; (2) persistent or intermittent pain occasionally radiating to the abdomen or between the scapulae; (3) tenderness over the spleen; and (4) cachexia. Secondary anemia was a frequent symptom which usually occurred early in the course of the disease. Pleural effusion was present in 16 per cent and ascites in 20 per cent of the reports collected by Smith and Rusk. Spontaneous rupture of the spleen was reported in three patients (Hauptman; Bush; Kendall). Fever and leukocytosis were inconstant.

Sequelae of Splenectomy. Smith and Rusk reported that splenectomy, subtotal splenectomy or enucleation of the tumor was carried out in thirty-nine patients.

undoubtedly be attributed to faulty surgical technic in vogue in the early days of splenectomy. Thirty-two patients survived the surgical procedure, but of this number, eleven (34.3 per cent) showed the presence of metastases, local recurrence or extension on subsequent examinations, at intervals ranging from five weeks to nine years after operation. Of the patients who apparently recovered, there were twenty-one (65.7 per cent) who showed no recurrence or metastases at the time the condition was reported; but due to the fact that insufficient time had elapsed postsurgically, it is highly probable that many succumbed from extension of the tumor, recurrence or metastases.

Hausmann and Gaarde wrote that of the forty-five cases reviewed between 1923 and 1940, the spleen had been removed in eighteen. Four patients died within thirty hours after operation. Of the remaining

fourteen, two died within one year. Twelve were alive for intervals ranging between thirty days and eight years. Exploratory

soft collapsible nodules may be noted projecting above the level of the splenic capsule.
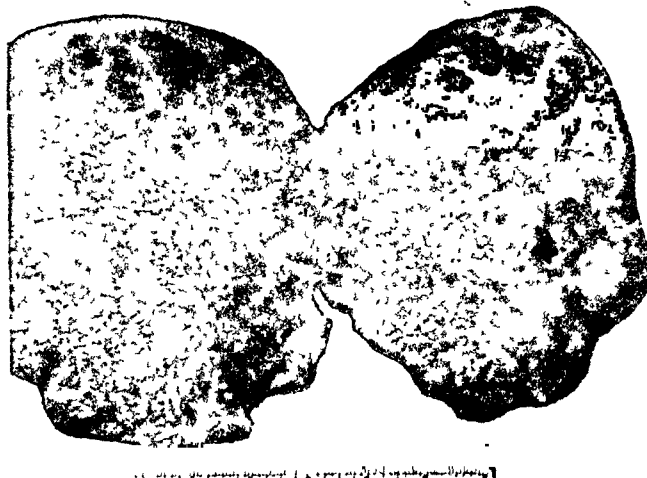

FIG. 3.   FIG. 4.

FIG. 3. Surface view of tumor.
FIG. 4. Sagittal section, showing tumor opened. Note irregular appearance of cut surface.

laparotomy showed the tumor to be inoperable in four patients. In the Mayo Clinic series of nine patients, splenectomy was carried out upon seven. One patient succumbed immediately after operation. The survival period of four others were nineteen days, three months, nineteen months, and four years, respectively. Two patients with fibrosarcoma of the spleen were found to have tumors which were inoperable.

Histopathology. The spleen is always enlarged, often reaching enormous proportions. The tumor may be localized to a part of the splenic mass, but usually is so extensive that it completely replaces the splenic tissue. At times a thin rim of splenic pulp may be identified, but as a rule little if any normal splenic structure can be recognized when the organ is sectioned. The cut surface shows numerous whitish nodules dispersed through a reddish or bluish-red background. In the vascular tumors, ordinarily designated as angiosarcomas, many large spaces containing blood clot or soft dark-reddish, necrotic bloody material can be seen. In the solid tumors, rounded, dark-reddish,

Microscopy. Although the pulp is usually recognized in occasional small areas, most of the splenic structure is obliterated. Tumors belonging to this category, particularly angiomas, commonly show narrow channels and dilated cavities filled with blood. In some areas these vascular spaces are lined with atypical, undifferentiated cells growing rapidly and profusely. The growth of tumor cells may be so rapid and exhuberant that they are crowded together and buckle into the splenic sinuses as papillary projections. The single cell has a scanty cytoplasm, and a large vesicular nucleus which almost completely fills the cell. The chromatin, which is scanty, appears as minute granules irregularly distributed throughout the finely reticulated nucleoplasm. Nucleoli are absent as a rule, but mitotic figures are frequently found. Some parts of the tumor appear fibrous. The presence of spindle cells is not uncommon.

CASE REPORT

Mrs. C. C., aged thirty-three, married and the mother of two children, was seen December 23, 1944, because of pain in the lower abdomen and left flank, extending over a period of

several months. Two months previously she experienced a severe attack of pain in left loin accompanied by fever and weakness. Since

Roentgenologically, a large diffuse shadow was seen filling the left hypochondrium. A left retrograde pyelogram showed the renal pelvis
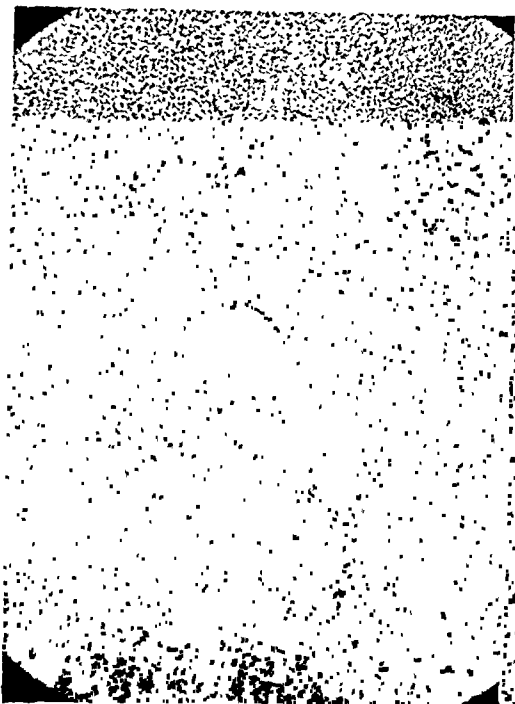

FIG. 5. Microphotograph (low power) showing remaining portion of recognizable splenic parenchyma with Malpighian corpuscles.

FIG. 6. Microphotograph (low power) showing solid syncytial tumor tissue and capillary and vascular spaces containing red blood cells (hemangio- and endotheliomatous architecture).

then she had felt weak and had progressively lost weight, approximately twenty pounds. Pain in the loin never completely subsided. Although constipated all her life, this symptom increased in severity during the present illness. Anorexia was present. She noticed no blood in the stools. There were no urinary or cardiorespiratory symptoms. The past history was entirely irrelevant.

Physical examination showed a fairly well developed anemic woman, thirty-three years of age, who appeared chronically ill. The outstanding feature of the examination was the presence of a large tender tumor occupying the left upper abdominal quadrant. There was definite left costovertebral tenderness. The muscles of the upper abdomen were held rigidly. The liver edge was not palpable. Vaginal and rectal examinations disclosed no abnormalities. Rectal temperature was 101°F., pulse 140, blood pressure 130/80.

Cystoscopy revealed no abnormalities in the bladder, and the urinary specimens obtained from both kidneys showed no abnormal cellular elements.

with a displaced upper calyx situated in close proximity to the vertebral column. The kidney proper was not enlarged, but situated directly above it there was a large diffuse shadow which appeared to be extrinsic to the kidney, but which displaced the organ downward and mesially. (Fig. 1.)

A barium enema showed narrowing of the upper part of the descending colon and broadening of the distal end of the transverse colon. The splenic flexure was displaced downward and mesially. (Fig. 2.)

Laboratory data were as follows: Urinalysis: Specific gravity 1.008; hydrogen ion concentration 5.5; albumen, faint trace; sugar, negative; microscopic 1 to 2 white blood cells per high power field. Blood Count: Hemoglobin 36 per cent; red blood cells 2,150,000; white blood cells 37,600; segmented polymorphonuclears 81 per cent, non-segmented 4 per cent, young forms 2 per cent, lymphocytes 11 per cent, myelocytes 2 per cent. The erythrocytes showed central achromia, poikilocytosis and anisocytosis. Sedimentation Rate: 34 mm. in one

hour. Tentative Diagnosis: Left infected perirenal tumor.

Operation (J.A.L.) was performed on December 27, 1944. Under gas and ether anesthesia the left loin was opened through a 12 inch Albarren incision. Extending from the under surface of the diaphragm to the pelvis, and over beyond the midline of the body, there was an enormous, soft, ovoid, lobulated tumor as large as a canteloupe, which appeared to be superimposed and partly adjacent to the left kidney. The latter organ, which appeared somewhat reduced in size, was displaced downward and mesially, but was in no way involved by the tumor mass. The splenic flexure of the colon was displaced downward. There were extensive adherent blood clots between the tumor and the attached portion of the peritoneum. The tumor, which was closely adherent to the undersurface of the diaphragm and to the lateral peritoneum, presented extensive hemorrhagic nodules directly under its capsule, giving the tumor its nodular appearance. The vascular pedicle appeared to enter the tumor on its mesial border close to the upper pole.

With considerable difficulty the tumor was delivered into the wound, and in doing so, the peritoneum was widely opened. Exploration of the abdomen failed to disclose any metastases. The pedicle of the tumor was triply ligated with chromic catgut and divided. The rent in the peritoneum was closed with a running suture of plain catgut. A rubber dam was placed beneath the diaphragm and a small tube into the renal fossa. The wound was closed in layers. One unit of plasma was administered during the surgical procedure, and 500 cc. of whole blood directly following operation. Convalescence was entirely uneventful.

The pathological report was as follows: "Macroscopic: The specimen consists of a football sized mass, measuring 25 by 15 by 11 cm. It has the shape of an enlarged spleen with a large and a small notch in one border. The surface of the mass is well encapsulated, predominantly flat, with flat undulating prominences. (Fig. 3.) There are no nodular or boss-like masses and no penetration of the surface by its contents. Parts of the surface are thin, shiny, smooth, with pinhead sized tubercle-like white thickenings. Other parts of the surface are dull, show fibrous, weblike adhesions and numerous small and larger conglomerate

dense white patches. On section, splenic tissue as such is not grossly recognizable. There is, however, a thin rim of tissue in the subcap-
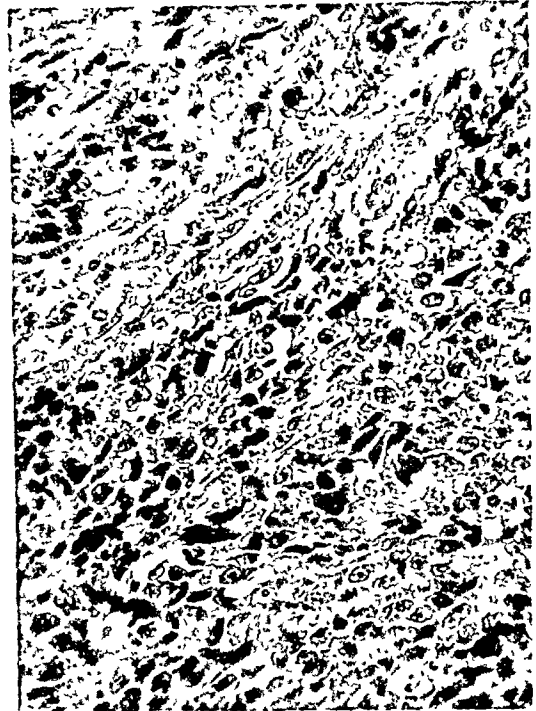

FIG. 7. Microphotograph (high power) showing solid tumor tissue with syncytial architecture, nuclear polymorphism, atypism and mitoses.

sular area which is more homogeneous and fleshy. This rim measures 1.5 cm. in its widest portion and is of a uniform blue-red hue. The remainder of the extensive cut surface consists of tissue which shows marked mottling of (a) bright and dark red, nodular, but not encapsulated, friable tissue; (b) bright red, hemorrhagic, necrotic tissue; and (c) irregular streaks and conglomerate foci of grayish white dense firm cellular and fibrous appearing tissue. These resemble anastomosing white nodules and strands upon a blue or bluish-red background, containing areas suggestive of clotted blood. (Fig. 4.)

"Microscopic: Sections through the subcapsular fleshy part reveal remnants of splenic parenchyma with definitely recognizable splenic corpuscles containing a central arteriole and a mantle of dark round cells. (Fig. 5.) This mantle is of varying thickness. Elsewhere the splenic architecture is completely obliterated. This zone is replaced by abundant cellular tumor tissue and markedly hemorrhagic, cellular and fibrotic areas, and areas containing

irregular spaces filled with extravasated and clotted blood. The tumor tissue shows four types of architecture: (1) Syncitial Areas: These

500 cc. of citrated blood was administered. About this time she began to complain of severe pain in the region of the right knee.

FIG. 8. Femora showing metastatic tumor of right femur.

FIG. 9. Chest x-ray showing metastases of the lungs.

consist of a syncytial network of tumor cells with varying amounts of cytoplasm and nuclei varying from vesicular to dark dense and hyperchromatic. There are scattered and numerous regular and atypical mitoses. (Fig. 6.) (2) Endotheliomatous Areas: These contain lumina lined by somewhat more elongated cells, with more elongated nuclei. The lumina are small, slit-like and sieve-like. The lining cells, in places, also contain mitotic and atypical nuclei. (Fig. 7.) (3) Hemangiomatous Areas: These contain larger, irregular lumina lined by a single or multiple layer of cells varying from flat spindle-shaped and endothelial-like cells to more polygonal and syncytial cells with mitotic and atypical nuclei. The lumina are filled with blood, in places with clotted blood. (4) Fibromatous Areas: These consist of dense and loosely cellular stroma with mature spindle-shaped cells which are in continuity with the edges of the endotheliomatous and hemangiomatous areas.

"Diagnosis: Hemangio-endothelial sarcoma of spleen showing (a) extensive infiltration of splenic pulp; (b) no extracapsular infiltration."

Immediately following discharge from the hospital the patient was given a course of deep roentgen therapy. On January 8, 1945, owing to a severe secondary anemia, a transfusion of

Roentgenograms of the right femur and knee disclosed a large area of rarefaction in the medulla at the junction of the middle and upper third of the femur. (Fig. 8.) Approximately two months later she developed a persistent cough. Roentgen examination of the chest (April 13, 1945) showed massive pulmonary metastases. (Fig. 9.) At this writing the patient is confined to bed with widespread metastases.

SUMMARIZED CONCLUSIONS

Primary malignant tumors of the spleen are uncommon, but tumors taking origin from the endothelial lining of the splenic sinuses are rare (thirty-seven cases). The most frequent group of tumors of the spleen are the malignant lymphoblastomas. Although various terms have been used to identify the primary malignant tumors falling within the group arising from the endothelium of the splenic sinuses, careful examination of the morphologic features of the tumors fails to show any clear-cut differentiation between them to warrant the varied terminology. It seems to us that a great deal of confusion may perhaps be

Author	Sex	Age	Designation of Tumor	Outstanding Symptoms	Metastases	Operation	Autopsy
Smith and Rusk	M	60	Primary endothelioma	Pain left side of abdomen and back	Liver, pancreas, retroperitoneal lymph nodes, rib		Yes
Smith and Rusk	?	?	Primary endothelioma	?	?	?	?
Weichselbaum	M	21	Endothelial sarcoma	?	?	?	?
Langhans	M	30	Angiosarcoma	Pulsating abdominal tumor, pain	Liver		Yes
Wagner	F	27	Endothelioma (Marchand & Aschoff called it a large round cell sarcoma)	None	None	Splenectomy	
Pasinetti	M	47	Endothelioma	?	Liver, lungs		Yes
Albrecht	?	?	Cavernous angioma with sarcomatous changes. (Foix & Roemmele called it angiosarcoma. Smith & Rusk called it hemangio-endothelioma)	?	?	?	?
Bunting	M	40	Endothelioma	Abdominal pain, emaciation	Liver, pancreas, gastrohepatic nodes, subcutaneous tissue		Yes
LeFort and Legueu	M	56	Endothelioma. (Smith & Rusk call it angioma with transition to endothelioma)	History of malaria; large spleen, emaciation	None	Yes	
Theile	M	56	Angiosarcoma. (Risel claims this tumor similar to his own, LeFort's and Langhans')	Weakness, pain, leukocytosis, large abdominal tumor	Liver, lung stomach		Yes
Jepson and Albert	F	15	Fibrosarcoma. (Risel believes type of cell here suggests an endothelial origin)	Palpable tumor 5 months previously with dragging sensation	None	Splenectomy	
Böchelmann	?	1½	Angioma with definite sarcomatous areas	Tumor spleen	None	Yes	
Jores	F	45	Angiosarcoma	Large spleen	Liver		Yes
Risel	M	52	Endothelial sarcoma	Tumor of spleen	Liver		Yes
Temoin and Bonnel	F	27	Endothelioma	Abdominal tumor	None	Yes	
Jopson	F	33	Hemangiomatous endothelioma	Abdominal tumor and anemia	None	Yes	

Author	Sex	Age	Designation of Tumor	Outstanding Symptoms	Metastases	Operation	Autopsy
Gröhe	M	20	Lymphosarcoma (Smith & Rusk, also Bunting called it endothelioma. Risel called it lymphosarcoma)	History of previous fall followed by pain in left hypochondrium 8 months before death	Liver, mesentery, intestine, right pleura		Yes
Villard and Santy	M	22	Smith & Rusk called it angioma showing transitional changes to endothelioma	?	?	Yes	
Friedreich	M	56	Smith & Rusk, Bunting, & Weichselbaum called it endothelioma	None	Extension into diaphragm and tail of pancreas		Yes (death due to apoplexy)
Schönstädt	M	39	Mixed tumor—endothelioma and fibroma. (Smith & Rusk called it endothelioma)	Sudden onset 4 weeks before death	Right ilium dorsal vertebra, colon, stomach		Yes
Stengel	F	21	Neoplasm of spleen comparable to diffuse myeloma or certain infiltrating sarcomas of liver. (Smith & Rusk called it endothelioma)	Pain left upper abdomen tumor, loss of weight	None	Yes	
Cerkasov	M	11	Perithelioma. (Smith & Rusk called it endothelioma)	Tumor 1 year in duration	None	Yes	
Menetrier	M	47	Splenoma. (Smith & Rusk called it endothelioma)	?	Peritoneum, pancreas, suprarenal capsule, lung, lymph nodes		Yes
Golovina-Ammon	M	16	Angiomatous fibrosarcoma. (Smith & Rusk: angioma undergoing endothelial changes)	?	None		Yes (patient died of Tbc meningitis)
Foix and Roemmele	F	45	Nodular reticulo-splenoma. (Smith & Rusk: endothelioma)	Fever, anemia, cough, dyspnoea, tumor	Left suprarenal lymph nodes along splenic vein		Yes
Cesaris	F	76	Fibrosplenoma. (Smith & Rusk: angioma with slow transition to endothelioma)	Edema of legs, loss of weight	None		Yes (patient died of myocarditis)

Author	Sex	Age	Designation of Tumor	Outstanding Symptoms	Metastases	Operation	Autopsy
Arnott and O'Connor	?	?	Primary (?) cancer of spleen. (Smith & Rusk: endothelioma)	?	None	?	?
Orlandi	F	44	Primary diffuse hemangio-endothelioma	Tumor and pain in left hypochondrium	None	Yes	
Zeno and Cid	M	30	Hemangio-endothelioma	Pain in left hypochondrium and asthenia	None	Yes	
Wright	M	25	Primary malignant hemangioma	Pain in loins and back, swelling of abdomen asthenia, icterus, loss of weight	Liver	Yes	Yes
DelBuono	F	52	Hemangiosarcoma	Pain in left hypochondrium, asthenia	Cranium, spinal column	Yes	
Krumbhaar	F	75	Sarcoma of spleen	?	None		Yes (patient died of broncho-pneumonia)
Jones	F	55	Hemangio-endothelioma	Enlarged, tender spleen	None	Yes	
DeNavasquez	M	57	Angioblastoma	Pain in upper abdomen, left chest and axilla	Liver		Yes
Paine	M	64	Haemendothelioma	Abdominal pain, loss of weight, dyspnoea	Liver, bone marrow		Yes
Caldwall	M	33	Endothelioma	Pain in abdomen, nodules on trunk and neck	None		Yes
Biller	F	67	Endothelioma	Asthenia, loss of weight, anorexia, pallor	Lymph nodes		Yes

avoided if the tumors were placed in two main categories, namely, (1) non-vascular sarcomas arising from endothelium of splenic sinuses, and (2) malignant angiomas arising from the endothelium of splenic sinuses.

The pronounced symptoms are (1) a rapidly growing left upper abdominal tumor; (2) persistent or intermittent pain; (3) tenderness over spleen; (4) cachexia. These tumors are highly malignant, metastasize rapidly, and frequently involve the liver, and less frequently the lungs, regional lymph nodes and pancreas. The only treatment which offers slight hope is early splenectomy.

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SURGICAL CORRECTION OF CHIN MALFORMATIONS

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CHIN deformities are common congenital, developmental, and post-traumatic disfigurements which mar an otherwise pleasant and highly acceptable facial contour.

glabella and mentum are in a perpendicular line and the upper lip protrudes slightly in advance of the lower one. (Fig. 1.) Careful
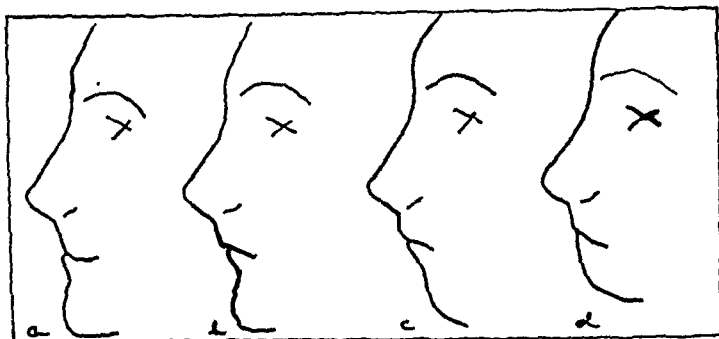

FIG. 1. Profile analysis of chin deformities: a, mild prognathism; b, normal chin; c, receded chin; d, receded and dwarfed chin.

These malformations are a detriment to the individual both socially and professionally and are often the subject for constant repeated cruel ridicule. Many unfortunates with an elongate nose and a marked underdeveloped chin have often been labeled "bird face," or "Andy Gump."

Facial features vary considerably between and among races. There is great discrepancy among peoples as to which features are considered ideal. Individual likes and dislikes vary. Those facial characteristics which appeal to one are averse to another. When a feature is slightly over or underdeveloped, it is accepted as "going with the face." Exaggerated deformity in one or more features, however, causes an unpleasant facial appearance an embarrassment to the patient.

An accurate chart of facial alignments is impossible to establish. However, general principles have been set up for the relationship between the components which make up the face. In the white race, the most pleasant profiles are those in which the

examination establishes the diagnosis as to what feature or features do not blend with the others. One or more may be at fault. Often, several malfeatures may be improved. In some cases, it is wiser to correct only the most marked deformity. Occasionally, when all the features are not in harmony, it is advisable not to attempt correction unless both the surgeon and patient have a good conception of the anticipated end result. This is especially important in patients with psychoneurotic backgrounds.

A chin which is hypertrophied or underdeveloped may not be a deformity in itself, but may be out of proportion in regard to the other features. (Figs. 2 and 3.) The most important features in relation to the chin are the superior maxilla and the nose. A chin which appears to be mildly underdeveloped may not be hypoplastic. The superior maxilla or upper teeth may protrude causing the jaw to appear small. Orthodentic treatment alone may be sufficient to correct the deformity. A prominent nose may cause a similar apparition. (Figs. 4 and 5.)

In planning a chin correction, it is essential to examine the patient in a completely relaxed state with the head erect,

Davis and Dunn[6] advocate an adjustable form attached to the infant's bottle which they state causes decided improve-

FIG. 2. A, preoperative photograph: humped nose and a moderately receded chin; B, postoperative photo after rhinoplasty and preserved cartilage chin implant.

the teeth occluded, and the lips closed. The patient is carefully observed while opening and closing the mouth. When the mouth is opened, the condyle of the mandible passes forward on to the articular tuberosity of the temporal bone while the mental protuberance describes an arc downward and backward. If proper nasal ventilation is obstructed either from a nasal occlusion or enlarged nasopharyngeal vegetations, the lower jaw is displaced posteriorly, and a microgenic or "mouth breather" appearance is assumed. In these cases, simple alleviation of the obstruction causes spontaneous improvement in the esthetic appearance. (Fig. 6.) It is essential, therefore, to determine whether the deformity is actual or apparent. Receded chins are evident soon after birth.

ment. During the growth period, the malformed chin is an orthodontic problem. The orthodontist improves, and in many cases, cures the chin deformities by restoring dental occlusion. In cases of bimaxillary protrusion where both the upper and lower teeth are protracted, the orthodontist corrects the protrusion by extracting all four first bicuspids and then retracts the protruding segments. If after restoring faulty occlusion the esthetic result is not satisfactory, as in the case of absent or hypoplastic mental tubercles or an underdeveloped mental protuberance, plastic procedures must be resorted to. The plastic surgeon's chief concern is the cosmetic end result and calls upon the more experienced orthodontist and oral surgeon for functional improvement.

Fig 3 A and B, preoperative photographs of nasal and chin deformity; orthodontia had been performed. C and D, postoperative photographs after rhinoplasty and preserved cartilage chin implant.

FIG. 4. A, preoperative photograph: prominent nose, short and receded chin; B, postoperative photograph after rhinoplasty and preserved cartilage chin implant.

FIG. 5. A, preoperative photograph: prominent nose with mild recession of chin; B, postoperative photograph after rhinoplasty and small preserved cartilage chin implant.

CLASSIFICATION OF THE UNDER-DEVELOPED CHIN

Hypoplastic chins may be classified as of five types: (1) Underdeveloped in a superior to inferior direction due to decreased height of the body of the mandible or absence or recession of the lower teeth; (2) underdeveloped in a lateral to lateral direction due to decreased width of the body of the mandible; (3) underdeveloped in an anterior to posterior direction due to dwarfing of the mental protuberance, absence of the mental tubercles, shortening of the horizontal rami, or a posterior dislocation of the temporomandibular joints; (4) underdeveloped unilaterally due to a unilateral first branchial arch and cleft malformation or a unilateral dislocation of the temporomandibular joint, and (5) underdeveloped in a combination of two or more of the above.

HISTORICAL DEVELOPMENT

Blair,[4] in 1909, after advancing a mandible by a bilateral section of the ascending rami for a marked retruded lower jaw, found he was unable to obtain sufficient improvement by this technic. He supplemented his operation by implanting a piece of costal cartilage together with the perichondrium under the periosteum of the chin and wired it in place. "A respectable chin resulted." Bilateral osteotomies through the ascending rami with advancement or recession of the mandible are successful in most cases. However, the potential danger of facial nerve injury causes one to substitute a simpler and as satisfactory method wherever possible. It is ideal to obtain proper occlusion of the upper and lower jaws, but a mild malocclusion is preferable to a possible facial paralysis. If a severe third degree retrusion or protrusion is present, bilateral section and advancement or recession of the mandible through the ascending ramus is justified. Thoma[42] believes that sections through the horizontal ramus are superior to those through the ascending ramus.

(Fig. 7.) In mild or moderate recessions, orthodontia supplemented by a chin implant offers the simplest and safest procedure. In addition, the discomfort of having the jaws wired together for several weeks is eliminated. The literature is voluminous on reported cases of mandibular ascending rami osteotomy and ostectomy, but only a few surgeons have had extensive experience in this type of sectioning. In their hands, the operative results are good. The average surgeon, however, resorts to the simpler chin implant method.

A review of the literature reveals that successful end results have been achieved by employing various substances as chin implants to build out an underdeveloped jaw. Paraffin, celluloid, and ivory, have been used with satisfactory results but have generally been discarded. The dermis, derma-fat, derma-fat-fascia, and the crest of the illeum, are the more recent substances preferred by some surgeons. Until the advocation of preserved cartilage by O'Connor and Pierce,[31] autogenous rib cartilage and the osteocartilagenous nasal hump, septal cartilage and bone were, and still are preferred by many. They stated that, "After a five year waiting period we find that all of the refrigerated cartilage isografts that have been transplanted have retained their original size and identity." Peer[32,33] has removed preserved rib cartilage at various intervals up to two years and has proven histologically that the "dead cartilage grafts showed progressive invasion by fibrous tissue and partial absorption." Dupertuis'[7] rabbit experiments showed that, "whereas the preserved ear cartilage was actively invaded and absorbed, the costal cartilage although dead, resisted fragmentation and degeneration rather well during a period of two hundred and forty three days." Lamont[22] found little difference histologically and clinically in the structural changes between autogenous and preserved rib cartilage.

Clinical observation of preserved septal cartilage implanted under the mucoperi-

FIG. 6. A, preoperative photograph: humped nose, marked deflection of nasal septum occluding both nasal passages; typical mouth breather. B, postoperative photograph after rhinoplasty and septum correction without chin implant.
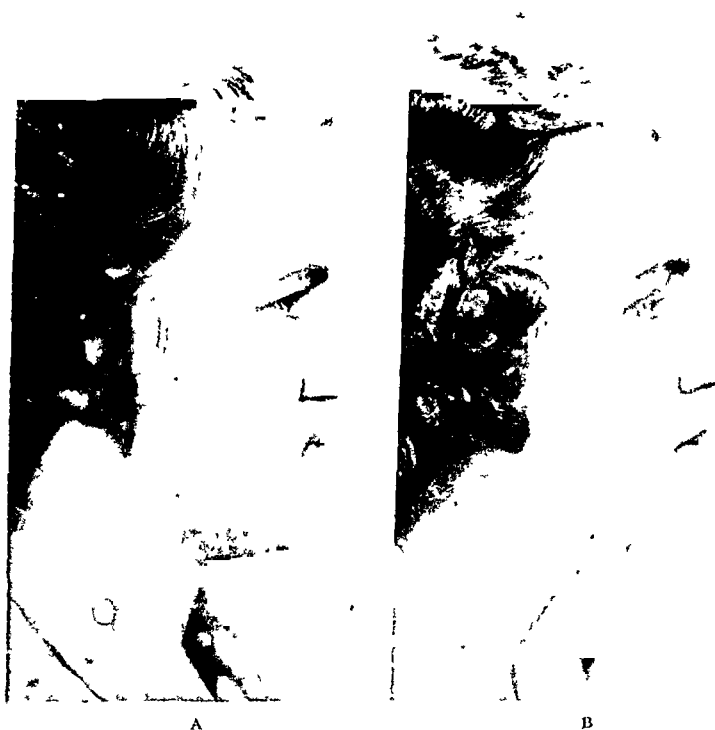

FIG. 7. A, preoperative photograph showing third degree chin protrusion. B, postoperative photograph eight weeks after performing a bilateral partial horizontal rami ostectomy with the coöperation of Dr. Benjamin Jacobs (oral surgeon) and Dr. Benjamin Weiss (orthodontist).

chondrium of the septum into the dorsum of the nose for saddle defects, into the scalp, eyelids and face, have given the im-

TECHNIC OF TRANSPLANTING PRESERVED RIB CARTILAGE INTO THE CHIN

A preoperative cast of the face for study purpose is helpful in estimating the size and shape of the proposed implant. Aufricht, in his teachings, emphasizes the value of guide lines. These are drawn by antiseptic colored dyes before the tissues are distorted by an infiltration anesthetic.

A   B
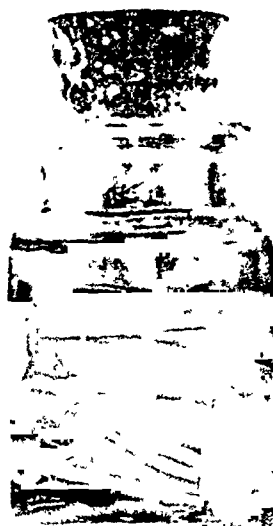
FIG. 8. A, preserved rib cartilage; B, preserved septal cartilage.

pression that this cartilage is partially absorbed and more so under the septal mucosa.[9] Preserved rib cartilage in good size pieces, however, seemed to resist absorption and the contours remained unaltered.

The cartilage was stored in 70 per cent alcohol after removing the perichondrium. (Fig. 8.) One is advised to make repeated cultures for sterility. Repeated examinations of both the cartilage and the solution has never shown the growth of an organism. Refrigeration of the preserved cartilage has proved unnecessary. Solutions kept at room temperature for as long as three years showed no organism. Preserved rib cartilage was transplanted into the chin in sixteen cases without complication.

Various configurations are sketched according to the deformity. For the routine symmetrical dwarfed chin the following lines may be of value: A center line is drawn vertically down the chin and submental region. (Fig. 9.) A transverse line is made in the existing sublabial sulcus or at the site of the proposed one if not present. Two vertical lines, parallel with the center line, are made marking out the proposed length of the transplant. A transverse line is made parallel to the sublabial line deliniating the width of the transplant. The thickness of the transplant is judged by placing it on the outside of the skin until the profile line is established. The last line is a small half-inch horizontal one drawn under the chin in a natural fold if

present, or on a level with the posterior border of the symphysis menti.

The cartilage is washed in fresh alcohol

FIG. 9. Guide lines for correction of the symmetrical dwarfed chin.

people is sufficiently thick to maintain the graceful fullness of the chin.

After local infiltration of a 2 per cent

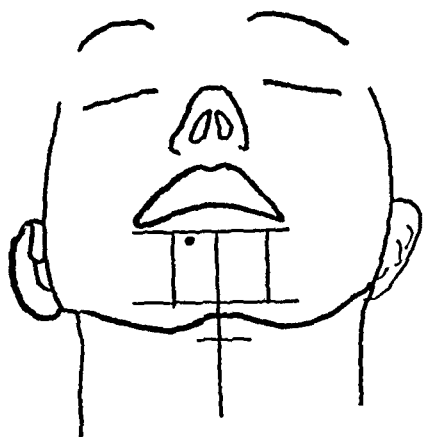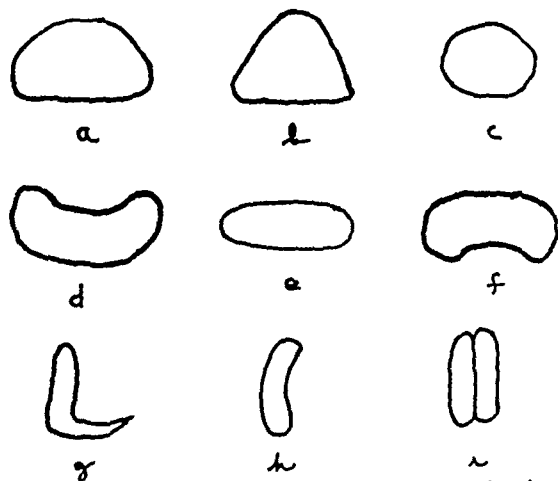FIG. 10. a, b, c, d, e and f, full view models of various shaped implants used by the author; g, h and i, profile views.

A   B

FIG. 11. A, preoperative photograph: prominent long nose associated with a mild prognathism; B, postoperative photograph after rhinoplasty alone.

and saline and modeled to correct the deformity. (Fig. 10.) All sharp corners are carefully rounded. The anterior surface of the implant may be flat and not necessarily rounded as the mentum pad in most

solution of procaine hydrochloride, a small half-inch submental incision is made down to the bone. A subcutaneous pocket in a plane just above the periosteum is dissected. The pocket is slightly larger than
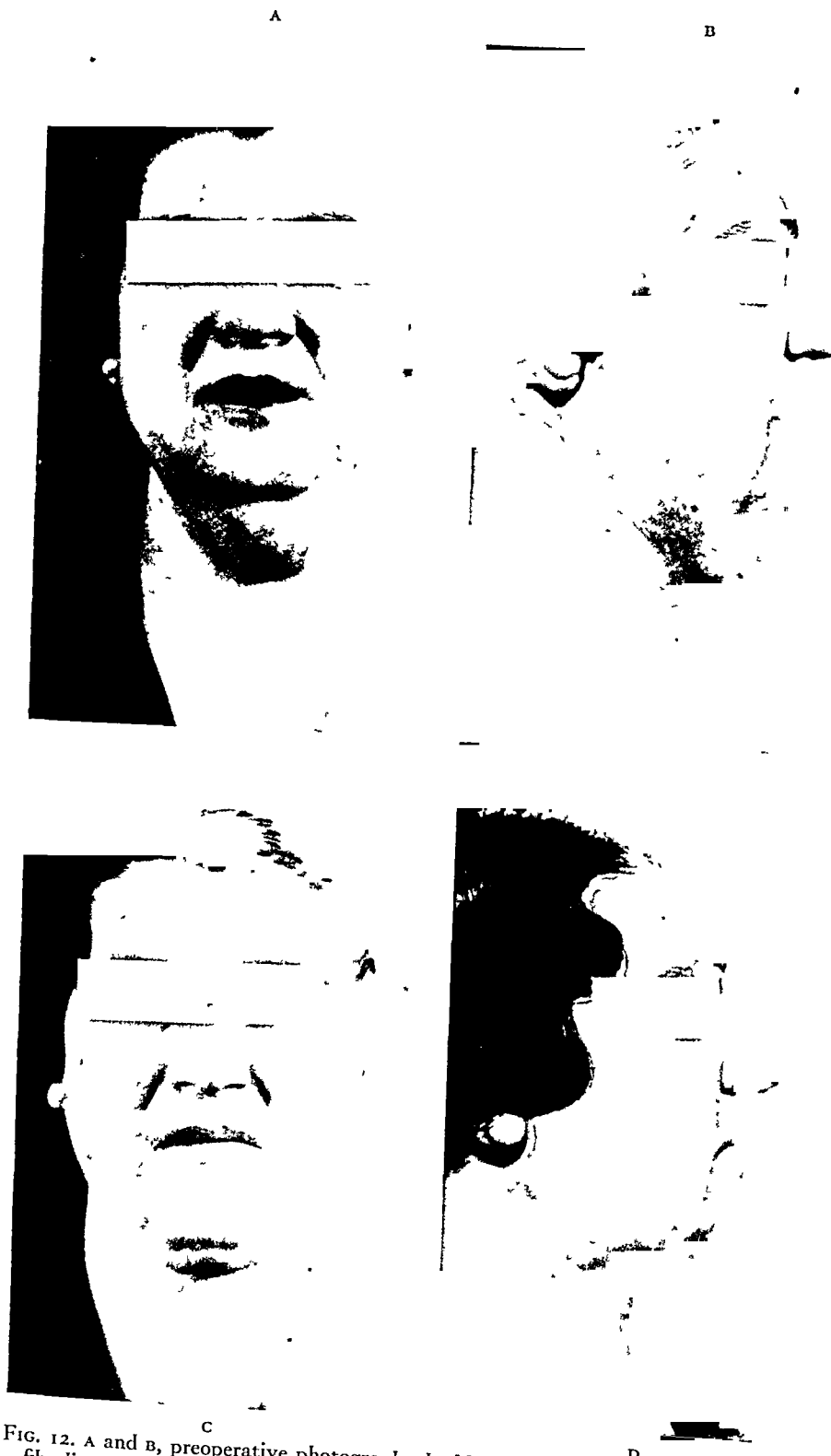
A

B

C

D

FIG. 12. A and B, preoperative photograph: double chin deformity due to a submental fibrolipomatous mass; C and D, postoperative photographs following surgical re-modelling.

the implant so that it may be manipulated into position. The undermining should not be superficial as the margins of the trans-
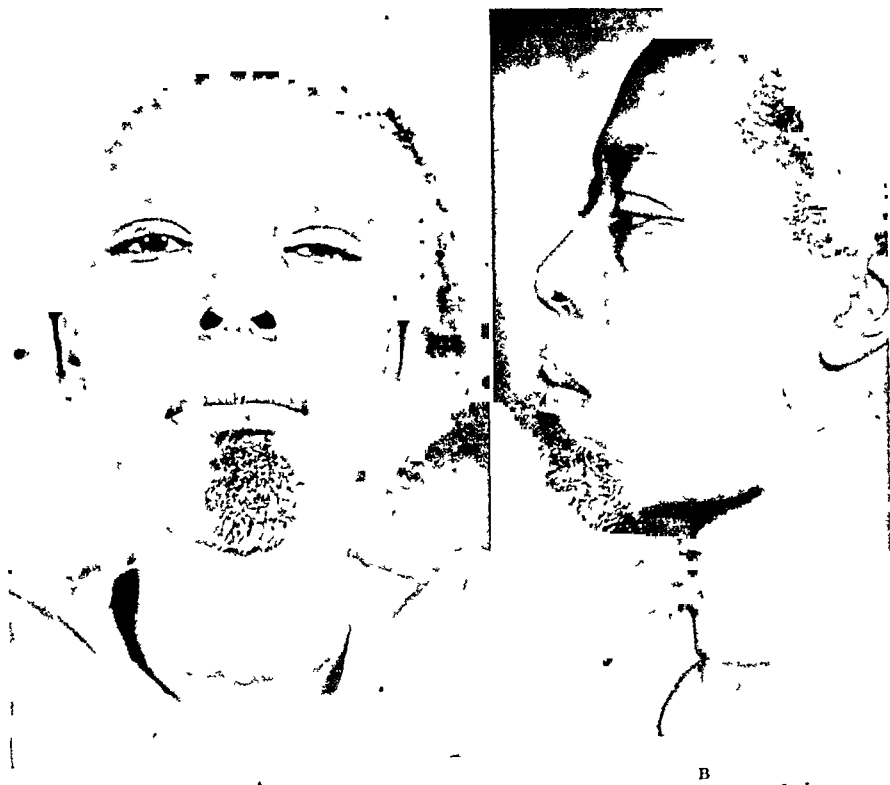

FIG. 13 A and B, "goatee nevus," nevus pilosus and pigmentosus of chin.

plant may be apparent and bulge; nor should it be so extensive as to allow room for displacement of the graft. The cartilage is inserted and the incision closed by a few fine sutures. No internal fixation sutures are necessary as the cartilage becomes fixed by the surrounding tissues. A firm compression dressing is applied to maintain the cartilage in place and prevent hematomas. No drainage is permitted. The dressing and sutures are removed after the fourth day. A mild ecchymosis and a moderate edema are usually present when the bandages are removed. These disappear in a few days.

If a nasal deformity is associated with a chin deformity, correction of both results in pronounced improvement. Most patients with underdeveloped chins consult the plastic surgeon for a nasal correction when the major deformity is usually the chin. If a mild prognathism is associated with a long nose, a simple rhinoplasty without

chin correction will give a gratifying result in most cases. (Fig. 11.)

Occasionally, a mass of fibrolipomatous tissue is deposited under the chin causing a double chin deformity. (Fig. 12.) It is easily corrected by employing a submental inverted T incision with the horizontal component in a natural fold. The chin is remodeled by partial subcutaneous excision of the mass. The superfluous skin is removed and the wound closed by subcuticular and fine skin sutures. Two small drains are inserted at both angles of the T and a firm compression dressing is applied to prevent the formation of a hematomas. Although an external scar persists, it is inconspicuous and the result is satisfactory.

CONCLUSIONS

1. The methods of treatment of chin deformities have been discussed. It has been emphasized that the chin is only one of several facial features which may distort one's facial appearance. The chin should blend harmoniously with the other facial features.

2. It has been suggested that in mildly or moderately retruded chins, orthodontia combined with a chin implant is preferable to a bilateral section of the ascending rami with advancement of the mandible wherever possible.

3. Preserved rib cartilage is suggested as a suitable foreign implant which will give gratifying esthetic results when transplanted into the chin to correct a recession.

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PRIMARY RESECTION OF MALIGNANT LESIONS OF THE LARGE BOWEL*

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DUE to the many advances in chemistry and physiology it is now possible to carry out a one-stage procedure in certain cases of malignancy of the bowel, thereby avoiding the long disability and economic loss as well as the disagreeable aspect of an artificial anus on the abdominal wall.

The early attempts at overcoming obstructive lesions of the bowel date back to about 1813, and were well established at least fifty years before the development of antiseptic surgery.[1] From that date many variations in technic were recorded,[2] and in 1884 Heineke described a multiple-stage resection of the colon which was the first time that a planned procedure was suggested for carcinoma of the colon, and this procedure was divided into three stages. In 1885, Colley was the first to suggest that in resection of a tumor of the large bowel the tumor should be left *in situ* until protective adhesions occurred. Block of Copenhagen, however, was the first one who actually carried out a three-stage operation and published his results. In 1902, Mikulicz described the details of a multiple stage aseptic method of removing a tumor of the large bowel, stating that his first patient was operated upon in 1886. As a result of all the previous work the so-called Mikulicz operation was developed, although Mikulicz did not claim priority.[3]

Further progress in surgery of the large bowel consisted in the obstructive resection or in certain cases primary anastomosis preceded by an enterostomy for decompression at some distance proximal to the obstructive lesion. For a carcinoma at the rectosigmoid junction or below, an abdominoperineal resection has usually been the procedure of choice. All of these procedures necessitate the presence of either a permanent or temporary artificial anus on the abdominal wall, with its disagreeable aspect and a prolonged period of disability.

At this time further advances in our knowledge of the physiology, chemistry and pathology involved brings up the question, should a one-stage operation with primary resection be the procedure of choice in the unobstructed case with lesions down to and including the rectosigmoid area. By an unobstructed case, I mean a patient who presents no obstructive symptoms or mild obstructive symptoms which can easily be overcome by suction and liquid diet. The amount of colon removed seems to bear no relation to the hazard of operation provided attention is given to the blood supply of that portion of the bowel which remains. The site of the lesion, however, determines the amount of the bowel and mesentery to be removed along with the lymphatics. These principles are already well established. The only portion of the large bowel in which a primary resection remains questionable is in the rectosigmoid. At the present time it is generally conceded that a malignant lesion in this region requires an abdominoperineal resection and a primary anastomosis is not feasible. The objection to a primary anastomosis in this region is based on the danger of recurrence and also the hazard of infection; i.e., peritonitis, abscess, or giving way of the suture line. In the light of our present experience only one objection can be raised and that would be the question of recurrence. No matter how objectionable

an artificial anus might be it could not compare with the tragedy of recurrence of the cancer. There are three routes in which carcinoma cells spread. (1) via blood stream, (2) direct extension, and (3) via the lymphatics. The two former present the same risk in either type of operation, so the latter seems to be the only question to be considered.

As David and Gilchrist[4] pointed out, it is relatively infrequent that we have retrograde spread of carcinoma through the lymphatics. With a primary anastomosis of the colon in the rectosigmoid area the dissection of the lymphatics can be quite as complete as though an abdominoperineal resection was performed. Therefore, the only safety factor which the latter procedure affords is the discussion of the glands in the depth of the pelvis. Certainly it must be admitted that a sharp dissection of the glands in the depth of the pelvis is far more theoretical than real.

PREPARATION

The period of preparation in the average case must be at least a week and longer if obstruction exists. Today we have well established principles of management of intestinal obstruction as outlined by Lichtenstein[5] which includes decompression by the Levine or Miller-Abbott tubes. Among the other advantages of this decompression, it leaves a bowel wall that can be safely sutured. The maintenance of fluid balance, electrolytes and proper blood levels of protein have been stressed by Meyer and Kozoll.[6]

We also have at our disposal the sulfonamides in the form of the relatively insoluble sulfasuxadine which renders the contents of the bowel relatively innocuous if spillage occurs. In addition, proper vitamin therapy is carried out, including the maintenance of normal blood level of vitamin C. Therefore, before a candidate for primary resection of the large bowel comes to surgery, the following criteria must be established:

The obstruction has been relieved by the use of suction and a liquid diet can be tolerated. The condition of the bowel wall is compatible with safe suturing, i.e., the obstruction has been relieved at least a week. The contents of the bowel have been rendered innocuous by the proper administration of sulfasuxadine over a period of four days or longer. The bowel is properly cleansed beginning forty-eight hours before surgery by multiple enemas and castor oil. Fluid and electrolytic balance have been corrected. A normal blood picture has been obtained by means of blood transfusions and plasma, amino acids, and a high protein diet. To obtain a true picture of the blood protein level and the albuminglobulin ratio, it is necessary to check the hematocrit; failure to do so will many times give one a false impression. Vitamin C is given in large doses, either hypodermically or by mouth so that a level of 1 or above is maintained at all times.

TECHNIC

The technic of primary resection of the colon with end-to-end anastomosis involves a thorough understanding of the blood supply of the large bowel. Many surgeons are reluctant to ligate the superior hemorrhoidal artery unless an abdominoperineal resection is done. However, Dixon,[7] of the Mayo Clinic, has shown that ligation of this vessel does not compromise the viability of the lower segment of the bowel which remains. A short fat mesentery limiting the mobility of the segments to be anastomosed is a contraindication for this procedure. A thorough dissection of the lymphatics must be carried out. After wide excision of the involved segment of the bowel and its mesentery the anastomosis is accomplished with interrupted fine silk or wire in two layers, any prominent vessels in the bowel wall having been individually ligated. Care must be taken that too large bites are not included in each suture because the turning in of a large cuff of bowel will predispose to undue narrowing of the lumen at the side of the anastomosis. The hole in the mesentery

that remains is sutured with plain No. (oo) interrupted catgut on its two sides. A total of 2 to 4 Gm. of crystal sulfanilamide are frosted about the operative site and in different levels of the abdominal wound. In low resections, when feasible, the peritoneum is closed above the operative site. No drainage is employed.

POSTOPERATIVE MANAGEMENT

It has been shown by some investigators that extensive adverse changes take place in the blood picture during, as well as after an operative procedure of this type. It is, therefore, imperative that whole blood, plasma or intravenous fluids be administered during and following the operation, so that normal levels of the blood compliments are maintained.[8]

Postoperatively, carbon dioxide-oxygen inhalations should be given as indicated and the patient allowed to sit up early to avoid pulmonary complications.

A rectal tube must be inserted frequently in order to prevent the development of pressure on the suture line, especially in low anastomoses. A Levine tube is also employed for decompression from above.

Beginning eight hours after surgery sulfonamides are given intravenously for a period of three to four days.

COMMENTS

With these principles in mind the author has had the opportunity of resecting twenty-seven cases of carcinoma of the large bowel in the past four years, using a one-stage procedure with end-to-end anastomosis and without a preliminary cecostomy. The locations of the carcinomas were as follows: Hepatic flexure, 4; trans-verse colon, 6; splenic flexure, 5; recto-sigmoid junction, 7; at or just above the level of the perineal reflection, 5.

The patients average stay in the hospital was eighteen days; the longest twenty-six and the shortest fourteen days. The temperature curve varied from normal to 101.2°. There was one death due to a pulmonary complication.

CONCLUSIONS

1. The period of observation in these cases is too short to evaluate the recurrence rate.

2. The technic described is not offered as an innovation but rather to demonstrate that in the light of our present knowledge of pre- and post-operative management, a primary one-stage resection of the large bowel carries with it no undue risk.

3. A primary one-stage resection is the procedure of choice for certain lesions of the large bowel rather than other methods which necessitate a prolonged period of disability accompanied by either a temporary or at times a permanent colostomy.

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GASTRODUODENAL INVAGINATION DUE TO A SUBMUCOUS LIPOMA OF THE STOMACH[†]

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THE differentiation of invagination of the bowel into enteric, ileocecal, and colic forms (Nothnagel, Wilms) has been considerably expanded. A complete enumeration of the forms of intussusception would include:

1. Esophageal-gastric
2. Gastric
   a. Gastro-esophageal
   b. Gastrogastric
   c. Gastro-enteric
      (1) Gastroduodenal
      (2) Gastroduodenojejunal
      (3) Gastrojejunal*
3. Enteric
   a. Enterogastric
      (1) Duodenogastric
      (2) Jejunogastric*
   b. Duodenoduodenal
   c. Duodenojejunal
   d. Jejunojejunal
   e. Jejuno-ileal
   f. Ileo-ileal
   g. Ileocecal
   h. Ileocecocolic
4. Colic
   a. Cecocolic
   b. Colocolic

Descending esophageal-gastric invaginations have as their basis mucosal hypertrophy or various tumors as cited by Henschen.[23] Clinically they may lead to a prolapse-stenosis syndrome which presents all the signs of a cardiospasm. Enderlen's account[23c,30c,45c] and that of Liaras and Ricard[29] are the only descriptions of a gastro-esophageal invagination. Both were found while dissecting anatomy cadavers and each comprised a widely dilated, pouch-like esophagus within which lay a portion of the stomach. The gastrogastric form has been reported as such by Baylac and Dieulafé[3] and Capua[9] but probably is more frequent as a transitional phase in gastro-enteric invaginations. Engel's instance of telescoping of the stomach so that the pylorus came to lie near the cardia was an incidental finding in a cadaver and the occurrence has been interpreted as an agonal self-invagination.[23c,30c,45c] The enterogastric intussusception is an infrequent though well known complication following gastroenterostomy. The mechanism is always retrograde. The first case was described in 1917 and by 1937 forty-three similar instances were available.[5,11] Of this type acute, chronic, intermittent, and Types I to III are now current.[44] The enteric forms are by far the most common and are adequately familiar even in lesser institutions. A description of 1,000 such intussusceptions was already given by Fitzwilliams in 1908.[19] Invaginations in the colon are not too frequent and are generally grouped with the enteric forms. The ileocecal and ileocecocolic types are fairly well represented.

It is the gastro-enteric form that interests us here now. The basis for our report was provided by a patient who sought advice in 1937 and required surgery soon thereafter. After waiting eight years it still represents the only case in thirty years of a busy surgical practice; another such case of the gastro-enteric type is hardly expected.

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* Forms after gastroenterostomy, the invagination occurring through the stoma.

Bockus'[7] encyclopedic treatise describes the entity briefly and mentions only one case, that of Wade[53] in 1917. A recent

Fig. 1. Roentgengram soon after admission showing an abrupt delineation of the contrast substance traversing the middle of the stomach. A few streaks extend longitudinally. These features constitute the "abrupt sign with spurs."

supplementary review is not available. The circumstances, recommend this survey. The occurrence of the lipoma in our case affords an opportunity to summarize this form of benign gastric tumor.

CASE REPORT

The patient was a sixty-one year old, white female. When forty-nine years of age a panhysterectomy had been done (in 1925) since which she had been troubled with stubborn constipation. In 1934, she began to lose weight, was tiring easily but knew of no specific complaint. In November, 1935, she experienced a paroxysm of pain in the right upper quadrant of the abdomen which radiated through to the back and up to the right shoulder. It was accompanied by nausea and vomiting of a dark material. She was treated medically for gallbladder disease and recovered. Thereafter, she suffered other episodes of the same nature which, however, were less intense and were not associated with vomiting.

In December, 1937, the patient suddenly developed inability to retain food in her stomach. This episode had begun much like her previous gallbladder attacks. The pain was mild, but soon the vomiting became severe and prominent. It persisted for three days; whereupon, the patient was admitted to the hospital by Dr. S. M. Allerton and referred to the senior author. Her bowels had been moving; the stools were not tarry, red, nor clay colored. For about a year prior to this development she had become aware of a tumor mass just above the umbilicus. This had been growing slowly, could be moved about freely, and was not tender.

Physical examination presented a well constituted, poorly nourished woman, whose skin was dry, pale, and pasty. The abdomen was soft and not tender. A healed mid-line scar was present below the navel. A freely movable, firm mass was felt in the epigastrium and estimated to be about 3 by 5 cm. This tumor was irregular in outline and gave the impression of being located in or around the transverse colon. The remainder of the examination disclosed no other morbid conditions. The admission diagnosis was obstructive carcinoma of the transverse colon with metastatic obstruction of the pylorus.

A gastrointestinal series on the second day of hospitalization was reported as follows: The patient was too weak for a regular fluoroscopic examination, thus, only a glance was obtained. It was sufficient to disclose that the antrum of the stomach was not filling and that a retention of barium was occurring in the upper half. Chest, heart, and esophagus were normal. The regular films showed an advanced obstruction apparently involving the lower half of the stomach. (Fig. 1.) A fluid level was noted below the stomach. At six hours, the appearance was unchanged and only a very small amount of barium had left the stomach. At forty-eight hours, there was at least 50 per cent residue in the stomach and the colon was filled only in flecks. In the right flank there were eight grouped shadows each not over 1 cm. in diameter, all of which had the characteristics of opaque stones in a ptotic gallbladder. Conclusion: Obstructing lesion in the antrum of the stomach, forty-eight hour residue, obstruction of the bowel with fluid level, opaque gallbladder stones.

The laboratory data were all negative except: Hemoglobin 56 per cent, red blood cells 3,200,000; icteric index 6; urine; faint trace of albumin, few hyaline casts, much pus.

On the fifth day of hospitalization the patient developed severe, generalized pain in the abdomen accompanied by rigidity and tender-

The first portion of the duodenum was elongated, under marked tension, and had rolled over the invaginated stomach. The normal
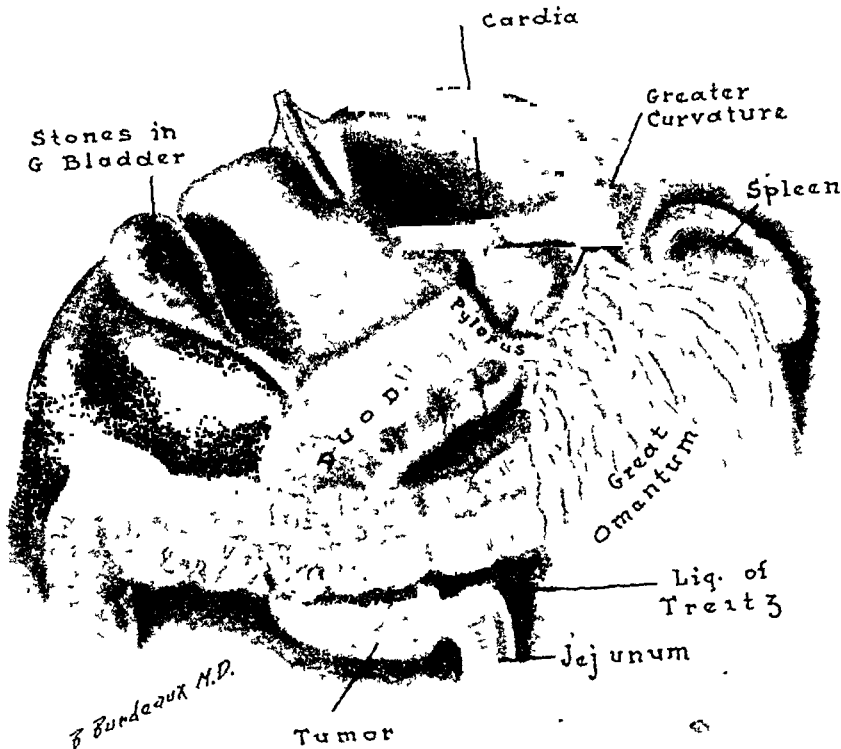

A

FIG. 2. A, the anatomic relationships encountered during the laparotomy; B, close up of the duodenal segment.

ness to palpation. An enema returned dark, tarry feces. A laparotomy was performed on the ninth day.

A right paramedial incision was made extending from the costal border to the umbilicus. The right rectus muscle was reflected distally and the abdomen opened through the posterior rectus sheath and peritoneum. The pathological condition was immediately obvious: At least two-thirds of the stomach had become invaginated into the duodenum. (Fig. 2A and B.) The engaged stomach was wrinkled into broad folds but no area of puckering had developed. The uninvolved portion of the stomach was not dilated. The pylorus was evident as a thinned, pale ring of tissue and formed the proximal stoma of the intussuscipiens. The intussusceptum had pulled the greater portion of the omentum into the duodenum. The latter was dilated in its entire length and measured up to three inches in width. (Fig. 2B.) At the ligament of Treitz the distention ended abruptly.

horseshoe configuration was intact and the duodenum was firmly fixed; no displacement had occurred. The pancreas, bile ducts and pylorus were also in their normal topographical relationships. At the duodenojejunal junction a tumor mass could be palpated which was freely movable and was estimated to be four inches long by three inches in diameter. The gallbladder was distended and adhesions were noted between the gallbladder, duodenum and transverse mesocolon. The gallbladder contained numerous calculi.

By means of slight traction on the cardia combined with a milking manipulation retrograde toward the pylorus disinvagination could be easily effected. Considerable hyperemia and edema had developed in the duodenum, stomach, and omentum. The circulation of the disengaged bowel segments was not impaired. After total reduction of the intussusception, a large intragastric tumor could be palpated. During the manipulations the pyloric ring

rapidly regained its tonus and the duodenum contracted down to 1.5 to 2 inches. A gastrostomy was performed in the anterior wall of the

Following a transient bout of atonicity of the stomach with delay in emptying as seen in a gastrointestinal series, the patient made an
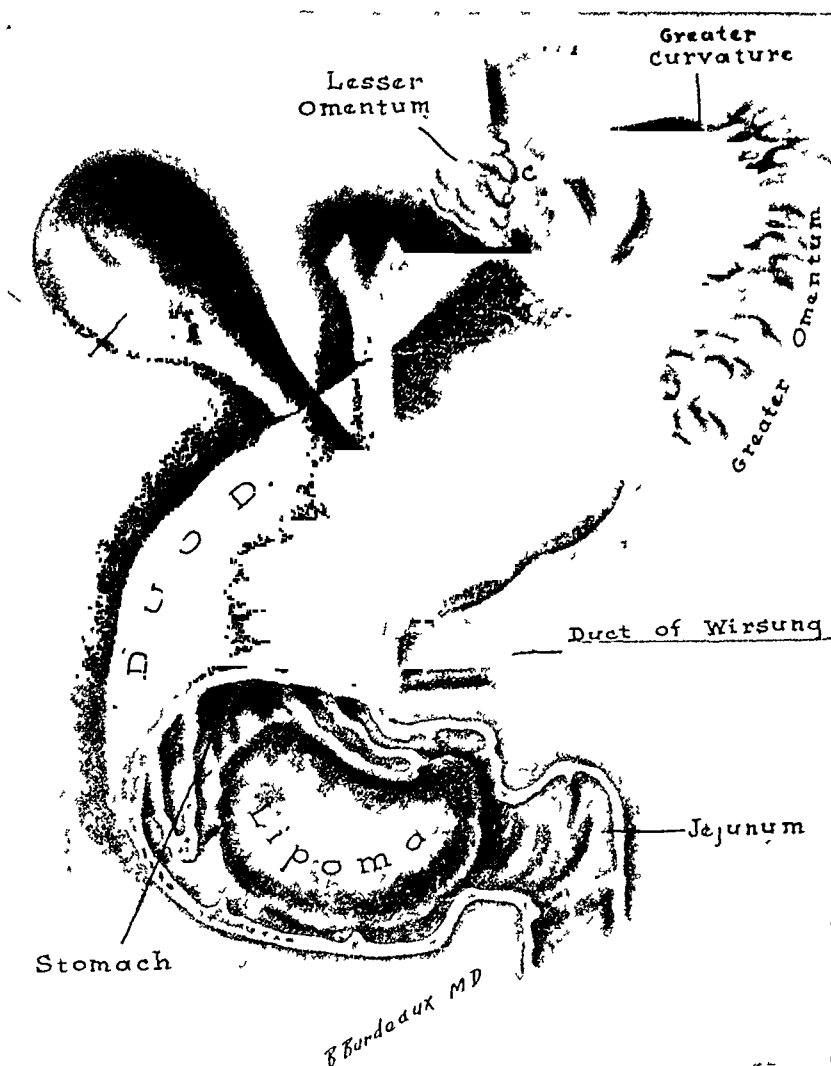

FIG. 2B. For descriptive legend see page 507

stomach transversely from the lesser to the greater curvature and the contents examined. A large, pedunculated, soft tumor was disclosed attached to the posterior wall of the stomach by means of a broad, short pedicle.

At the time, there was uncertainty as to the nature of the tumor. In view of the broad pedicle and the absence of adhesions in the lesser omental sac which could cause interference, it was believed wiser to do a sleeve resection of the morbid portion of the stomach. The excision included wide areas of normal tissue on either side of the tumor. (Fig. 3A and B.) After the gastric anastomosis a cholecystectomy was performed in the usual manner.

uneventful convalescence and was discharged from the hospital on January 15, 1938. She has been observed medically during the intervening years. There has been no symptomatology of any sort referable to the intestinal tract In October, 1944, the patient reported for surgical check-up. Her statement was that she has not known a day of sickness since she left the hospital. She is now sixty-eight years old, has no restriction of diet and never has had to curtail any of her activities. She has gained about twenty pounds of weight which was her approximate normal weight previous to the obstructive mechanism which brought her to the doctor in 1937.

Dr. V. W. Bergstrom described the specimen as follows (Figs. 3A, B and 4): "The tissue consists of a collar of stomach about 4 cm.

Bockus[7] explain that the majority of benign tumors are too small to cause symptoms and consequently are never

FIG. 3. Resected portion of the stomach with the tumor: A, before and B after disinvagination. A collar of stomach surrounds a soft tumor mass which is covered over by gastric mucosa. The surface is corrugated; a shallow ulcer is present near pedicle. On section the tumor is composed of lobules of fat.

across the lesser curvature and 8 cm. across the greater curvature. Attached to the latter and also arising from the posterior surface is a tumor 8 cm. long by 6 cm. in one diameter and 5 cm. in the other diameter. The attached end (the pedicle) is about 4 cm. in diameter, the free end has a low indentation in it. The surface of the tumor is somewhat corrugated, resembles slightly the lining of the stomach, and is markedly injected. A shallow ulcer 2.5 cm. in diameter is noted near the attachment. The tumor is very soft. On section beneath the mucosa the specimen appears to consist of a large lobule, or lobules, of pale fat.

"The gallbladder measures 9.2 cm. by 3.8 cm. The serosa is smooth, the wall is not thickened. On section 9 small facetted gallstones consisting almost entirely of pigment are found in the lumen. The mucosa is infiltrated with cholesterin and is rather thin.

"Microscopically, the tumor in the pyloric end of the stomach is a benign lipoma covered with gastric mucosa showing chronic inflammation and interstitial hemorrhage. Chronic cholecystitis."

EVALUATION OF THE LIPOMATOUS COMPONENT OF THE PRESENT CASE

The incidence of benign gastric tumors cannot be adequately estimated. It is supposed to be rare but Comfort[12] and

discovered. Even at autopsy many of the smaller intramural lesions can be overlooked and the incidence varies with the zest of the author. Root[40c] encountered seventeen benign gastric tumors in 250,000 admissions, twelve of which were proven by surgery or autopsy. Rigler and Erickson[40] in 1936 found twenty-five benign tumors of the stomach in 4,236 gastrointestinal examinations (1.6 per cent). Finesilver[21] in 1942 reported an estimated 43,200 gastrointestinal x-ray series studied in the period of eight years; six revealed benign tumors of the stomach. Stewart[40c,55c] surveyed 11,000 autopsies and encountered seventy-eight benign gastric tumors. Rigler and Erickson[40] reported forty-seven benign neoplasms in the stomachs from 6,242 autopsies. Rienets[40c] who was meticulous with 200 consecutive autopsies could tally thirty-two instances with one or more benign tumors of the stomach and twelve instances with cancer. Dudley, Miscall, and Morse[55] surveyed 76,077 adult surgical and medical patients admitted during three years and seven months (1935–1938). They found six benign tumors (1.3%) and 450 malignant (98.7%); 0.6% of all their admissions were treated for gastric tumors

Of 4,413 autopsies performed at Bellevue Hospital[55] during five years (1930–1934), 145 revealed tumors of the stom-

FIG. 4. Microphotograph showing a section of the lipoma with its covering of gastric mucosa.

ach (3.28%); 32 were benign, 113 were malignant.

Some idea of the ratio of frequency between benign and malignant tumors of the stomach can be had from the following data: Eusterman and Sentry[17] reported twenty-seven benign tumors which represented 1.3 per cent of 2,168 gastric neoplasms operated at the Mayo Clinic 1907 to 1921 (e.g. 1:77). But 2,285 additional neoplasms were inoperable. This indicated that only one of 166 gastric tumors was benign. At the Lahey Clinic[27] in a period of five years the diagnosis of benign tumor was proven in six cases while the diagnosis of cancer of the stomach was made 265 times in the same period (1:44). The proportion in Rigler and Erickson's clinical material was 1:9, in their autopsy cases 1:3; Stewart's ratio computes to 1:6; Finesilver's 2:1. "The general estimate that 0.5–5% of gastric tumors are benign is too low. The figure is more probably 15–20%."[55]

Eliason and Wright,[16] Minnes and Geschickter[34] have made analyses of all

tumors of the stomach as have been reported in the literature. In Table i these major compilations are compared. From it one can appraise the relative infrequency with which the lipoma appears as a benign gastric tumor. Records of the Mayo Clinic[12] show twenty-four submucous gastro-intestinal lipomas in a total of 3,924 necropsies, four of which were in the stomach. Eliason and Wright found one

TABLE I

BENIGN TUMORS OF THE STOMACH
As compiled from the literature

	Eliason and Wright 1925—610 cases		Minnes and Geschickter 1936—931 cases	
	No.	Per Cent	No.	Per Cent
Myoma........ ..	325	53.2	344	36.9
Polyp...........	49	8.0	182	19.5
Neurofibroma....	...	....	102	10.9
Papilloma........	60	9.8	89	9.5
Adenoma........	36	5.9	42	4.5
Fibroma.........	29	4.8	42	4.5
Lipoma..........	29	4.8	32	3.4
Polyposis...	12	2.0	16	1.7
Hemangioma.....	10	1.6	15	1.6
Lymphadenoma..	14	2.3	14	1.5
Endothelioma....	...	....	12	1.2
Osteoma........	1	.2	1	.1
Osteochondroma..	1	.2	1	.1
Myxoma....	3	.5		
Unclassified... ..	11	1.8		
Cysts....... ...	30	4.9	38	4.1
simple...... ..	...	....	29	3.2
dermoid.... .	...	...	5	.5
echinococcus...	..	....	4	.4
	610		931	

lipoma of the stomach in 8,000 necropsies Of Stemmler's[12e] 17,000 postmortem examinations nine disclosed lipomas. Comfort[12] surveyed all reported incidences of submucous lipomas of the alimentary tract to 1931, added twenty-eight cases of his own and brought the total to 181 incidences. Of these twenty-two were in the stomach. Rumold[42] in 1941 compiled thirty-three cases of submucous lipoma of the stomach as reported in the literature during 1835 to 1940. He has sum-

marized each case in tabular form. Of these, seventeen were found at autopsy and sixteen had been resected at operation. The size varied from a pea to that of an orange; the sex incidence was found to be equal; the age incidence varied from 29 to 84 years. This author concluded: "Less than 1 per cent of all tumors of the stomach are benign and only about three per cent of the benign tumors are lipomas." Since Rumold's article five additional cases have appeared.[10,13,28,49,56]

In summary, the benign gastric tumor is relatively infrequent yet adequate numbers of them have been described. Of these the lipoma is the least frequent of the more important non-epithelial types. Ours is the thirty-ninth case to be reported in 120 years.

EVALUATION OF THE PRESENT
INSTANCE OF GASTRODUODENAL
INVAGINATION

Classification. Invaginations involving the stomach are the least frequent of the intussusceptions which are known to occur in the bowel. Henschen,[23] Vulliet,[52] and Lonnerblad[30] have in part reviewed cases reported. None is complete and enough has subsequently appeared to make a summary desirable. In Table II all available instances which have been called gastric or gastroduodenal intussusception have been compiled. They tally forty-one items. Not all, however, meet the criteria as encountered in our own case. The intussusception occurred in twenty-five women and eighteen men. The age incidence varied from twelve years to seventy-eight. In practically every instance a tumifaction was present in the stomach and could be included in the pathogenesis of the condition. These tumors comprised ten polyps, six polyposis, ten adenomas or fibroadenomas, two papillomas, six myomas or fibromyomas, one case each of sarcoma, carcinoma, hemangioma, lipoma, and neurinoma. The number of cases on the basis of mucosal hypertrophy is relatively high but could not be counted.[15,39,57,58] A case of

lipoma of the stomach which herniated into the duodenum was reported by Daza and Zunega.[13] Ours is an instance of a gastric lipoma giving rise to a gastroduodenal invagination which descended to the ligament of Treitz.

All of the recorded instances represent approximately 4 per cent of the gastric tumors. Although there are still few in number, enough cases and types are available to allow for a regrouping and classification.

Firstly, an intussusception may be *complete* or *partial* depending upon whether the entire thickness of the stomach wall or only the mucosa or the tumor is involved. Schmieden[45] Pendergass,[39] Henschen,[23] Eliason and Wright[16] and more recently Eckhoff,[15] Norgore and Shuler,[57] Weinberg and Raider[58] have stressed the importance of a gastric polypositas or of a hypertrophied gastric mucosa creeping down the stomach wall to obstruct the pylorus or invaginate into the duodenum. These are *partial* forms as are also the instances of an intraluminal gastric tumor embedding itself in the pylorus or having transversed the pyloric ring eventrates into the duodenum. Fiori[20] described a polyp of the stomach that grew down into the jejunum; the gastric wall was slightly umbilicated but no invagination had occurred. In the *partial* forms only the juxtaluminal constituents enter into the condition while in the *complete* type the musculature, serosa, and the ligaments of the stomach are also involved. (Fig. 5.)

Secondly, the intussusception can be *central* or *lateral*. In the former the whole circumference of a portion of the stomach is symmetrically and uniformly pulled into a succeeding section of the stomach or into the duodenum. Therewith, the axis of the invagination coincides with or is parallel to the long axis of the stomach. In the lateral form, on the other hand, a funnel shaped puckering is present on one of the surfaces and the axis of the intussusception is at an angle to that of the stomach. (Fig. 5.)

more rapid, the sedimentation rate was accelerated and a palpable, tender mass appeared in the left upper quadrant. For a
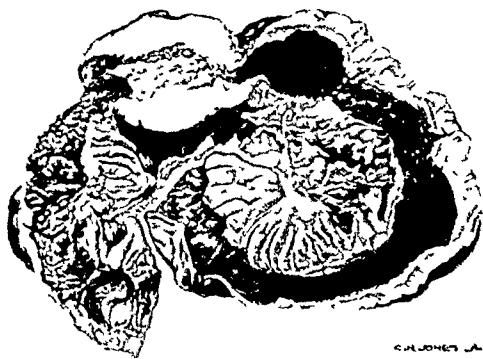

FIG. 2. Drawing of the surgically removed specimen which has been opened. The peritoneal surface of the bowel is thickened. The wall of the intestine is thicker and less flexible than normal. In a few places the wall is markedly thickened and stiff. There are areas of narrowing of the intestine, at which point there is great thickness of the wall of the gut. The mesentery of the middle portion of the loop is greatly thickened and very dense in consistency. The mucosa shows irregular folds which run in all different directions. The submucosa is greatly thickened by dense, white, fibrous tissues. At one point the gut narrows down to a circumference of about 1½ cm. At this point the lumen is barely passable for a medium size probe. Beyond this obstruction there is a perforation of the wall of the gut which communicates with the peritoneal cavity.

period of two weeks prior to this episode, he had been receiving sulfasuxidine in large doses. A clinical diagnosis of perforation of the jejunum and formation of an intraperitoneal abscess was made. Treatment was expectant until July 10th, when, because of increasing pain and tenderness in the left upper quadrant, progressive anemia, increased sedimentation rate and daily rise in temperature, it was believed that exploration was again indicated.

Consequently, on July 10, 1944, the patient was again operated upon. The involved portion of the jejunum was resected and a large intraperitoneal abscess was evacuated. The lesion showed evidence of much more extensive inflammation than was noted at the first operation. The organism isolated from the abscess was a streptococcus susceptible to penicillin. Consequently, the patient was

placed immediately on this form of therapy. He received a total of 2,750,000 units, over a period of two weeks. Improvement was gradual until August 6, 1944, when it was noted that he again began to complain of pain in the left upper quadrant, with signs and symptoms of an acute inflammatory reaction. It was thought that this probably represented an exacerbation of his intraperitoneal abscess and he was again placed on penicillin therapy, receiving 4,125,000 units, over a period of twenty-one days. The patient then went on to make a satisfactory recovery. X-rays of the terminal ileum revealed no pathology. He had gained forty-four pounds in weight when he was discharged. Post-operatively he received a total of 3,000 cc. of whole blood 3,000 cc. of plasma, 5,000 cc. of Amigen, 298 Gm. of sulfadiazine, 184 Gm. of sulfasuxidine, and 7,150,000 units of penicillin.

The pathological report was as follows:

Gross: The specimen (Fig. 2) consists of several loops of small intestine measuring approximately 75 cm. in length. The peritoneal surface of the bowel is thickened and frequently shows yellowish-white dots measuring about 1 mm. in diameter; in addition there are many remains of fibrous adhesions. In the middle portion the serosa shows extensive hemorrhages. Dense fibrous bands bind adjacent portions together thereby causing severe kinking. The wall of the intestine appears thicker than normal and is in general less flexible. In a few places the wall is markedly thickened and stiff. There is narrowing of the intestine in a few situations. In such areas there is usually great thickening of the wall of the gut. The wall of the middle portion of the small intestine is rigid and board-like. There are severe tears of the serosa and the wall of the intestine in this area. A portion of the mesentery is attached to the intestine. The mesentery of the middle portion of the loop is greatly thickened and very dense in consistency. On opening the intestine the circumference of the proximal portion measures 6 cm.; its wall measures 5 mm. in thickness. The mucosa shows rather irregular folds which run in all different directions. Occasionally folds are quite prominent and appear edematous. The submucosa is greatly thickened by dense, white fibrous tissue and there is moderate hypertrophy of the muscularis toward the middle portion of the specimen.